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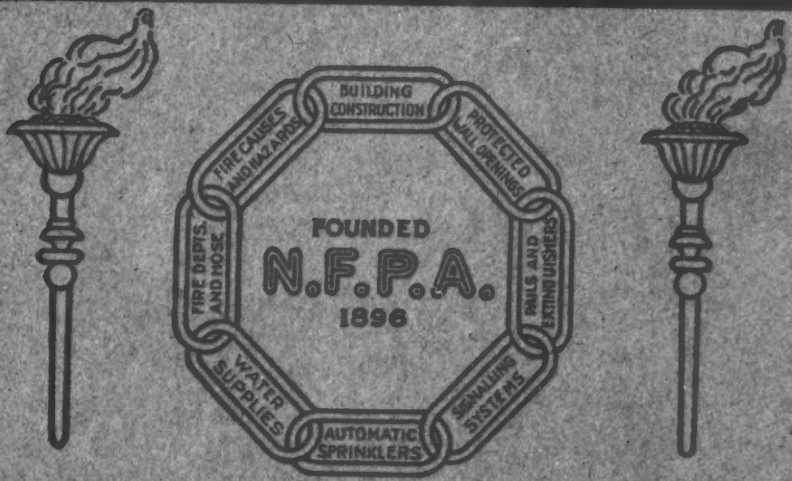
OF THE

NATIONAL FIRE PROTECTION ASSOCIATION



"To Promote the Science and Improve the Methods of Fire Protection and Prevention."

PUBLISHED QUARTERLY AT BOSTON, MASS., BY THE
NATIONAL FIRE PROTECTION ASSOCIATION

Printed in U. S. A.

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Vol. 28 July, 1934 No. 1

QUARTERLY

OF THE

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National Fire Protection Association

INTERNATIONAL

Executive Office, 60 Batterymarch Street, Boston, Mass., U. S. A.

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Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

Chicago Tribune.

Airplane view of the burning Chicago stock yards, showing flames sweeping through wooden pens and runways. Note fire traveling against the wind along 43rd St. viaduct toward Armour & Co. office building (center foreground). See text, page 61.

The Quarterly

Vol. 28 July, 1934 No. 1

The Atlantic City Meeting. The Proceedings of the thirty-eighth annual meeting, published as Part 2 of this QUARTERLY, reflect a note of enthusiasm and optimism that was evident through the discussions. Whatever the fortunes of the individual members and delegates, the collective attitude of those present was one of enthusiastic and confident attack on old and new fire problems, an attitude perhaps not specifically enunciated by the individual speakers, but nevertheless evident as an underlying pattern through all the sessions. Many of the reports and papers reflected achievements in the face of the obstacles and handicaps of the depression years, and indicate constructive results in both the technical and general divisions of the Association's activities. With an increasing membership built around the nucleus of loyal and devoted members who for years have dedicated themselves to the advancement of the cause of reducing needless loss of life and property by fire, and with the renewed energy and enthusiasm evident at our Atlantic City meeting, we may confidently anticipate real progress in every department of our activities during the coming year.

* * * * *

Will the Stockyards be Rebuilt or Replaced? The Chicago Stockyards fire of May 19, 1934, is described in detail in this issue of the QUARTERLY. We hope that Chicago has learned the lesson of this fire and will rebuild the burned area with proper fire protection in mind and not simply replace it.

The situation is very pithily described in the report of the National Inspection Company of Chicago to its subscribers:

> If we refer to the pen and shed areas of the yards as a wilderness, which we think, from past experience in trying to get about in it, is a proper description, it is a fair statement to point out that as soon as the fire got into civilization it was stopped. By civilization we mean an area where a systematic arrangement of streets and alleys and a regular distribution of fire hydrants prevailed so that fighting men could comprehend where to go, how to get in and how safely to get out and could get water anywhere. Of course, it was good work by a large and well-directed fire department with abundant apparatus that turned these values into a cold dead stop on a conflagration which easily could have ripped through to Lake Michigan. We feel sure that with the same advantage the fire would have been kept in the pens.

What is most urgently needed right now is to carry civilization, so to speak, into this wilderness which has been the yards—and may be again if radical action is not very quickly taken by authorities interested. The unburned areas, particularly north and west about Exchange Avenue, are fully as hazardous as the burned area if not more so, and there is a hazardous remnant in the southwest corner of the yards area about Racine Avenue and 45th Street. It is for the interest of the whole meat packing industry as well as the safety of the city to eliminate this menace.

* * * * *

Taxation and Fire. The proceedings at Atlantic City emphasized various aspects of relationship between the fire problem and the problem of taxation, which is of such general present concern. The removal of dilapidated buildings, mentioned by several speakers, is promoted by the desire of property owners to save tax payments. The immediate effect may be to reduce the tax receipts of the city, but the eventual result must be to relieve the municipality of a burden of fire protection and a conflagration menace, with advantage far outweighing any temporary loss of revenue.

The losses of tax revenue that are serious are those resulting from the burning of valuable properties, burnings which are often directly or indirectly chargeable to the presence of danger spots of old and highly combustible construction which contribute almost nothing to tax receipts. A significant illustration of the effect of fire on tax receipts comes from Tillamook County, Oregon, following the forest conflagration of last September (January, 1934, QUARTERLY, page 198). The assessors have just reported a valuation of $6,841,970 for the forest property in this county, compared with $15,169,180 before the fire, a most serious situation where timber was the largest item of taxable property in the district.

* * * * *

One Effect of the Drought. The Middle West has been going through a prolonged drought since the first of the year. The lack of snow and rain for weeks at a time, especially during the cold weather, when furnace fires were necessary, has brought about a substantial increase in wooden shingle roof fires. The roofs are dry and the chimney sparks find ready tinder to feed on. Take Detroit as an example. Detroit has a lot of wooden shingle roofs. Last year Detroit had over 2300 wooden shingle roof fires, more than any other city that we know of. This was bad enough, and certainly substantial argument for the adoption of the new building code with its provisions prohibiting wooden shingle roofs that we have been advocating for some years, but this year will break all records. In February alone Detroit had 1051 wooden shingle roof fires, 139 of which took place on one day, February 9th. This is more fires than many good sized cities where shingle roofs do not prevail have in a year. There were 713 such fires in Detroit in March, 96 of which occurred on one day, and there were 300 more in April.

Toledo, another large city where wooden shingle roofs are plentiful, has had similar experience. Toledo had 461 wooden shingle roof fires last year, 31 per cent of all its fires in buildings. During March of this year alone there were 109 shingle roof fires out of 340 fires in the month, or nearly 25 per cent of the number of shingle roof fires in the whole year before.

Chief McFarland of Marion, Ohio, another wooden shingle roof city, advises that an average of 45 shingle roof fires a month have occurred since the first of the year, two to three times the normal average. Undoubtedly other cities with this hazard, such as Buffalo, Ft. Wayne, Flint and Lansing, are having similar experiences. Our cities pay a heavy price for permitting wooden shingle roofs, and the great dry spell makes the situation very plain.

Meetings of Board of Directors.

Atlantic City, May 14, 1934.

Present.

Albert T. Bell, Chairman
Sumner Rhoades, President
H. L. Miner, Vice-President
Geo. W. Elliott, Vice-President
F. T. Moses, Past President
Franklin H. Wentworth, Managing Director

Eugene Arms
F. R. Bradford
Eugene Chrystal
A. H. Kehoe
S. D. McComb
C. W. Mowry
S. L. Nicholson
C. W. Pierce
D. J. Price
A. R. Small
R. E. Vernor

Past President Dana Pierce was present as a guest.

The report of the Chairman to the annual meeting was approved.

The report of the Treasurer was approved.

The report of the committee appointed at the last Board meeting to study the matter of Hazards and Protection of Homes and Small Properties was considered and approved.

A proposed resolution on the subject of the National Electrical Code to be presented to the annual meeting by the International Association of Municipal Electricians was submitted by its President, W. H. Greenlaw, in person to the Board. After explanation by Chairman A. R. Small of the Electrical Committee respecting the nature of certain conferences at which he had been present when the present and future status of the National Electrical Code had been considered or discussed, it was voted to accept and

endorse Mr. Small's explanation and to assure President Greenlaw that no changes whatever are contemplated in the present routine of handling or sponsorship of the National Electrical Code by the N.F.P.A. and to request Chairman Small to repeat to the annual meeting in detail his report as made to the Board of Directors.

It was voted to hold the summer meeting of the Board in Boston on Monday, June 25.

Boston, June 25, 1934.

Present.

Albert T. Bell, Chairman
H. L. Miner, President
George W. Elliott, Vice-President
F. T. Moses, Past President
Sumner Rhoades, Past President
Franklin H. Wentworth, Managing Director

H. T. Cartlidge
A. O. Dawson
W. F. Hickey
A. H. Kehoe
C. W. Mowry
S. L. Nicholson
D. J. Price
C. W. Pierce
A. R. Small
R. E. Vernor

Business Transacted.

The following members were elected officers of the Corporation for the year 1934-1935:

President, Harold L. Miner.
First Vice-President, George W. Elliott.
Second Vice-President, C. H. Haupt.
Secretary-Treasurer and Managing Director, Franklin H. Wentworth.
Chairman, Board of Directors, Albert T. Bell.

It was voted to hold the 39th annual meeting at Atlanta, Georgia, during the week of May 13, 1935.

It was voted as the sense of the Board that future meetings of the Association should be held in alternate years at Atlantic City and Chicago.

The following Program Committee for the 39th annual meeting was appointed: The President, the Managing Director, and the Chairman of the Board of Directors, with authority to add to its membership.

Suggestions for the program of the annual meeting were discussed and referred to the Program Committee.

The Budget for 1934-1935 submitted by the Treasurer was amended and approved.

Messrs. W. F. Hickey and S. L. Nicholson were selected to complete the Nominating Committee for 1935.

The Advisory Committee 1934-1935 was appointed to consist of Albert T. Bell, Chairman, H. L. Miner, Geo. W. Elliott, C. H. Haupt and C. W. Pierce.

The appointment of A. R. Small and C. W. Rulon as N.F.P.A. representative and alternate on the Safety Code Correlating Committee of the American Standards Association for the two-year period January 1, 1934-36, was confirmed.

It was voted to authorize the President and the Chairman of the Board to appoint a special committee to draft a suggested automatic sprinkler ordinance to be presented to the next meeting of the Association by the Committee on Laws and Ordinances.

A committee of five, consisting of A. R. Small, Chairman, G. W. Elliott, A. H. Kehoe, C. W. Mowry and S. L. Nicholson, was appointed to investigate and report to the Board recommendations for control of the hazards of primary electric service installations.

No action was taken on suggestions to revise the membership of the Electrical Committee.

Committee Business.

(a) Committee on Gases:

Amendments to the Regulations on Liquefied Petroleum Gases were approved as follows:

6 (a) revise to read:

> "Aboveground containers shall be located not less than 50 feet from the nearest important building or group of buildings or line of adjoining property that may be built upon, except that they may be located within 50 feet, but not within 10 feet, of buildings devoted exclusively to gas manufacturing and distributing operations."

Informative note added at end of regulations:

> TANK TRUCKS FOR LIQUEFIED PETROLEUM GASES.
>
> Good practice requirements for the construction and operation of tank trucks for bulk transportation on highways were submitted to the National Fire Protection Association for tentative adoption in 1934. For advice on these and other details write to the Chairman of the Committee on Gases, H. E. Newell, 85 John St., New York, N. Y.
>
> The Interstate Commerce Commission has jurisdiction over interstate transportation by rail, water and highway. Copies of rules and regulations may be obtained from the Bureau of Explosives, 30 Vesey Street, New York, N. Y.

(b) Committee on Signaling Systems and Thermostats:

The following recommendations made by the committee were approved:

1. Add a fine print note under Rule 202-3 of the Municipal Fire Alarm System Regulation as follows:

> "In view of greater facility with which circuits may be run aboveground, it is not considered necessary nor advisable to provide in aerial fire alarm cables special conductors for supplying designating lamps at boxes. Where such conductors are provided in fire alarm cables, they shall be installed in accordance with the provisions of Rule 201-7."

2. Delete Paragraph 500-a of the Regulations for the Installation, Maintenance and Use of Proprietary Auxiliary and Local Alarm Systems for Watchmen, Fire Alarm and Supervisory Service.

(c) Committee on Hazardous Chemicals and Explosives:

The following additional sections for insertion in the Regulations for the Storage and Handling of Pyroxylin Plastics in Factories Making Articles Therefrom were approved:

FACTORIES USING FINISHED PYROXYLIN PLASTIC ARTICLES FOR ASSEMBLY WITH OTHER MATERIALS.

101. Storage of pyroxylin plastic in excess of 25 pounds, exclusive of what is in closed I.C.C. shipping containers, shall be in:

(a) Cabinets conforming to section 38;
(b) Special stock storerooms conforming to section 51; or in
(c) Vaults conforming to section 37.

102. Workrooms. Rooms in which pyroxylin plastic is stored or handled in amounts in excess of 25 pounds shall comply with the following:

(a) Partitions enclosing such rooms shall comply with the construction specifications of section 16, including protection of openings.

(b) Such rooms shall be protected by an approved system of automatic sprinklers.

(c) Heating equipment shall comply with section 17(a); where there is danger of pyroxylin coming in contact with radiators or steam pipes they shall comply with section 17(e) and (f).

(d) Lighting equipment shall comply with section 18(a), (b) and (c).

(e) At least one approved 2½-gallon extinguisher shall be provided for each 5000 square feet of floor area where pyroxylin plastic is handled. A liberal supply of water pails shall also be provided.

(f) Smoking shall be prohibited.

103. Handling of pyroxylin plastic material in workrooms shall be in accordance with sections 40, 42 and 43(b).

104. Softening and Heating, and Storage and Use of Flammable Lacquers and Cements in connection with pyroxylin plastic material shall comply with sections 45, 46 and 47.

With the adoption of this additional section it is proposed to publish a new edition of these regulations. In the last edition there are a few details on requirements for electrical installations, fire extinguishers, etc., where editorial changes would appear desirable to harmonize with the current standards of the Association. The committee was authorized to make such editorial changes if desired, subject to the review of the Committee on Technical Committee Procedure, and in so doing was requested to consider changing 102(b) above to read:

> Such rooms shall be protected by a system of automatic sprinklers as approved for such occupancies.

(d) Committees on Flammable Liquids and Laws and Ordinances.

In the printing of the Range Oil Burner Ordinance an editorial change in paragraph 2 of Section 1 was authorized. The revised paragraph reads:

> This ordinance does not apply to portable burners not requiring connection to a flue, such as oil stoves, oil heaters and oil lamps equipped with a wick or a mechanical device, the movement of which is essential to flame adjustment, or to such portable apparatus as blow torches, soldering pots, etc.

The insertion of the same paragraph in Section 1 of the Suggested Oil Burner Ordinance was authorized.

No action was taken on the question of the policy involved in the inclusion in the above ordinances of sections requiring certificates of approval before installation of oil burners.

(e) Committee on City Planning and Zoning:

The following amendments to the 1934 report to the annual meeting were approved. (Page numbers refer to the advance report.)

On page 12, near the top, insert a new paragraph as follows:

"Vision clearance at street intersections is worthy of the careful attention of city planning and zoning authorities. Additional width and setback requirements at street corners should be of very considerable value in minimizing traffic hazards and facilitating the movement of fire apparatus at these points."

On page 12 amend the concluding sentence in the first paragraph at the top of the page to read as follows:

"Automobile parking areas which are sought by city planners and strictly enforced 'No Parking' regulations applying to busy streets, are not only effective means of clearing streets for the benefit of business, but are also of great aid to fire protection."

On page 25 add the following at the end of the second paragraph under "Building Heights and Setbacks."

"In view of the undesirable results produced by the excessive limits prevailing in many cities, considerable less liberal limits would be desirable for many reasons, not the least of which is fire protection."

On page 15 change the paragraph on "Blighted Areas" to read in part as follows:

". . . . . 8% for relief and social service, but also the large percentage of 15% of all fires and 14% of the total cost of the city's fire protection which in the slum area surveyed was $81.47 per $1000 of appraised value of buildings as compared with $4.40 in the entire city. Similarly, a survey of the basin area of Cincinnati, which constitutes 6% of the area and 28% of the population of the entire city, discloses that the area accounts for 59½% of the fire losses of, and 64% of the major offenses committed in, the entire city. Surveys of other cities will doubtless reveal similar conditions."

Insert a map showing a typical house numbering system.

The following resolution submitted by the committee was approved, providing funds were appropriated by the government for the purpose indicated:

"Whereas the Home Owners' Loan Corp. has been authorized by Congress to loan money for the purpose of reconditioning properties of home owners in financial distress, and

Whereas, recent surveys of certain slum or blighted areas of several of our large cities have disclosed the large increase in both the fire losses in, and the cost of providing fire protection for, such areas as compared with the cities as a whole, as well as the considerable increase in crime, vice, delinquency, disease, and in the cost of police, welfare and other services in each such area as compared with the entire city,

Therefore, Be It Resolved, that the Board of Directors of the National Fire Protection Association, an organization devoted to the conservation of life and property from fire, recommends to the Home Owners' Loan Corp. the rejection of all applications for reconditioning loans applying to property situated in such areas as are classified as slum or blighted districts destined by Housing and/or City Planning and Zoning Authorities for clearance, re-planning and/or re-zoning, excepting, however, such properties as are approved by the said authorities for modernization or replacement, and that the National Fire Protection Association offers its services to the Home Owners' Loan Corp. and local authorities in connection with the classification and rehabilitation of such areas from the viewpoint of protection of life and property from fire.

Be it further Resolved, that a copy of this Resolution be transmitted to the Home Owners' Loan Corp. and drawn to the attention of Housing and City Planning and Zoning Authorities."

The President was authorized to appoint a new standing Committee on Static Electricity.

Committee on Technical Committee Procedure.

(a) The committee requested approval for release as a tentative interim amendment, of a revision of the first paragraph of section 612 of the Regulations for the Installation of Sprinkler Equipments (Edition of 1931), proposed by the Committee on Automatic Sprinklers, subject to further review by the Sprinkler Committee and action at the next annual meeting of the Association, as follows:

> "612. Size of Dry-Pipe Systems. Dry-pipe valves controlling 300 sprinklers or less will not ordinarily require the attachment of a quick-opening device. Dry-pipe valves controlling more than 300 sprinklers should be provided with an approved quick-opening device. Not more than 600 sprinklers should be controlled by one dry-pipe valve. The inspection department having jurisdiction may modify either of the above limits where conditions of construction, hazard or occupancy warrant."

The recommendation of the committee was approved.

(b) On recommendation of the committee it was voted to join with the other members of the Fire Protection Group in approving a proposed enlargement of scope of the A.S.A. project on Petroleum Products and Lubricants.

(c) On recommendation of the committee, various technical committee appointments were approved, and the committee was authorized to proceed with further changes in technical committee personnel now under consideration, subject to confirmation at the next meeting of the Board. (The revised personnel will be shown in the 1934 Year Book.)

Sprinklers in Boston Apartment Houses.*

The tragic fire record of New York tenement houses last winter, in which forty-eight persons were burned to death in sixteen fires occurring between November 3rd and March 21st, stimulated quite a number of cities to inquire if the fire safety of their own tenements was being looked after. Boston and Bostonians have the reputation of being complacent about a good many things, but not many persons are aware of how well a law of the State of Massachusetts applying to the City of Boston takes care of the fire hazards of such serious import as menace the flat-dwellers in New York. Langdon W. Post, Tenement House Commissioner, says there are 67,000 "old law" fire trap homes that are known to exist in New York and these have existed for thirty-five years at least. "Old law" tenements are those which haven't even the minimum standard of construction for the protection of human life demanded by the law of 1901 for tenements subsequently erected.

The Massachusetts law applying to Boston, adopted in 1921, was not drawn with the object of leaving undisturbed the tenements already constructed in which there was danger to life from fire. It incorporated some of the provisions of the New York law, such as those requiring the enclosure of elevator and stair shafts in fire-resistive material, the lighting of public halls

*Franklin Wentworth in *Journal of Commerce*, N. Y.

and stairways, and the provision of fire doors in certain locations. But it did not contain the clause "tenements hereafter erected," the clause that leaves over sixty thousand fire traps still untouched after more than three decades in New York, with people burning to death in them every winter. The Boston law reads, "Every tenement house *now* or *hereafter existing*." This law began to bite in Boston as soon as it was enacted.

But this Massachusetts law of 1921 did not confine itself to providing structural improvements alone. Its advocates had the notion that if the retarding of a fire by fireproofing partitions might save a few lives, the extinguishment of a fire at the start might save a few more. There was the automatic sprinkler. The thirty-eight years of statistics compiled by the National Fire Protection Association show an extinguishing efficiency of 96% in apartment and hotel buildings protected by automatic sprinklers and nobody burned to death in a sprinklered apartment or hotel fire. So the law for Boston was made to read:

> In all tenement houses of second and third class construction, hereafter erected, being more than three stories high and containing more than ten suites, the basements or cellars, kitchenettes, stairway enclosures and elevator, light, ventilating and dumb-waiter shafts shall be provided with a system of automatic sprinklers approved as to situation, arrangements and efficiency by the building commissioner.
>
> The building commissioner may require the basement or cellar of a tenement house of first class construction, more than three stories high and containing more than ten suites, where in his opinion a fire hazard exists, to be equipped with a system of automatic sprinklers approved by him as to situation, arrangement and efficiency.

"First class" construction is fire-resistive throughout; "second class" has brick, stone or concrete walls with wooden interior; and "third class" is all wood. Boston has all kinds. The law was made retroactive for buildings of the second and third class by the inclusion of the following paragraph:

> Basements or cellars in existing tenement houses of second and third class construction, being more than three stories high and containing more than ten suites, shall be provided with a system of automatic sprinklers approved as to situation, arrangement and efficiency by the building commissioner.

In buildings of all three types of construction having first floors of "first class" construction the decision is left with the building commissioner, who may waive the requirement for sprinklers except in cases where, in his opinion, a fire hazard exists.

It is interesting to learn just how these sprinkler equipments have been behaving that the Massachusetts law has compelled the tenement landlords to put in. There are available records of 166 fires in such properties since the law was enacted. In 143 of these, the fires started in rooms required by the law to be sprinklered. In each of these the sprinklers operated satisfactorily, either holding the fire in check or completely extinguishing it. The remaining

23 fires out of the 166 started in the portions not required by the law to be sprinklered, such as the living rooms, etc. In each of these cases the sprinklers in the halls, kitchenettes or other divisions were a factor, keeping the fire from spreading until the arrival of the fire department. Not a life was lost in any of the 166 fires recorded. Here are details of these fires:

Table I. Fires Occurring in Sprinklered Sections.

	No. Fires
Basements	93
Hallways	22
Kitchenettes	13
Stairways	5
Rubbish chutes	5
Dumb-waiter shafts	2
Living rooms	2
Storage room, first floor	1
Total	143

It isn't difficult to see where most of the apartment house fires start. The living rooms and the first floor storage room in which three of the above fires occurred were sprinklered, although the law did not require it.

Table II. Fires Originating in Unsprinklered Sections.

	No. Fires
Living rooms or apartment rooms	16
Kitchenettes	3
Office	1
Awning fire outside, entered kitchenette	1
Stairway	1
Outside porch	1
Total	23

In most of the above only the basements or halls were sprinklered, the operation of the hall sprinklers confining the fires to the apartments until the firemen arrived. In forty-eight out of the 166 fires the sprinkler alarm, which is operated by the flow of water from the sprinklers, gave the fire signal. This too, is a factor worth evaluating.

There is another item entering into this tenement house safety problem which is calculated to reconcile the Boston landlords to spending money for sprinklers. It is the concession in the insurance rate made for these sprinkler installations by the Boston Board of Fire Underwriters. The underwriters generally have been reluctant to reduce rates on any building equipped with anything less than a complete sprinkler system. A complete sprinkler system is one covering by its protection every square foot of space on every floor. The Boston tenement law does not demand this. In the common parlance of the American underwriter, partial sprinkler installations are "sub-standard" and are likely to be dismissed with a negative gesture. The sprinkler installing companies have also, until very recently, assumed a similar attitude. They

have desired to install complete, "standard" systems, or none at all. This common attitude of both underwriters and sprinkler companies derives largely from habit of mind. It is not true that insurance companies must invariably be driven to recognize improvements that will reduce rates, nor that the sprinkler companies are determined to keep all the installation work in their own hands. Automatic sprinklers were originally a factory proposition. They were thought of and designed for big plants only. They were required to have two sources of water supply independent of each other, and the tanks, pumps, valves and other parts were so perfectly and completely devised and assembled as to make, in operation, the admirable record that has won for sprinkler systems the confidence of the world. The sprinkler companies do not want to see this fine record impaired and their business thus jeopardized by the possible and probable failure of extinguishing systems with only one source of water supply and other "sub-standard" features; and the underwriters are averse to putting their economic faith in anything less than the near perfection of the "standard" system, so laboriously and painstakingly evolved, which they are used to.

The necessities of fire protection, however, begin inevitably to press upon these conservative attitudes. The basements of city blocks and smaller buildings than factories and warehouses demand protection, and cities have begun to pass ordinances requiring sprinkler heads in such locations as do not justify the considerable expense of "standard" systems. Boston's tenement house law is a case in point, and the Boston Board of Fire Underwriters, a body of intelligent men, looks without prejudice at these partial installations and inspects and rates them on their merits as revealed by their fire record. There are about 500 apartment houses in Boston with these partial sprinkler equipments. Some of them have basement sprinklers only, some with hallways also, some with kitchenettes, or stairways, or rubbish chutes, or dumbwaiter shafts; and some with living rooms and closets sprinklered. The Boston Board of Fire Underwriters allows policy rate credits for these varying degrees of fire protection from 17½% for the best down to 2½% for the least, and reports that its experience has been uniformly good, even with the systems that are the least complete; that no loss of life has occurred in any apartment building so equipped, and that the property damage in fires has been small. There may be no harm in calling the attention of the rather numerous critics of the insurance business to the very great service the cause of human safety in Boston has received from its local underwriting body, which has so cheerfully assumed the considerable task of especially inspecting and rating these hives of human habitation and keeping them constantly under inspection to insure reliability, and by so doing adding as an influence upon the landlords the economic persuasion of a reduced insurance rate to the legal admonitions of the state.

Static Electricity As a Fire Cause.

By E. E. Turkington,
(Member N.F.P.A.)

The existence of static electricity has been well known for centuries, but it was not generally recognized as a fire hazard until comparatively recent years. Experience shows that static electric sparks can and do ignite flammable gases, vapors, dust-clouds, cotton in process of manufacture, and other easily ignitable fibrous materials.

How Static Electricity Is Generated.

It was originally believed that static electricity was generated only by friction between different substances and it was called "frictional electricity." However, Dr. Elihu Thomson has shown that static electricity is generated solely by contact and separation of two unlike substances regardless of friction. An outline of this theory as applied to a belt and pulley, for example, may be of interest.

A small difference of potential exists between different materials, which in the case of the belt and pulley is approximately two volts. As the belt leaves the pulley the adjacent surfaces act as an electrical condenser the capacity of which, following the law of all electrical condensers, decreases as the distance between the surfaces increases. If the amount of the electrical charge remains constant the potential will increase in proportion to the decrease in capacity. The charge is very small, namely, that resulting from the initial difference of potential of approximately two volts, but the distance involved is infinitesimal. If this distance is doubled the voltage will be doubled, and each time the distance is doubled the voltage will be doubled again. However, the increase in potential is limited by the dissipating effect of the edges of the belt, and a separation is finally reached which, if increased, gives no further increase in potential. A potential of many thousand volts is often obtained.

Static charges are undoubtedly generated in nearly all industrial and manufacturing operations, but in most cases they are dissipated or neutralized without becoming a fire hazard. Moreover, if a spark does occur, it may not be of sufficient intensity to ignite combustible material or there may be nothing combustible in the immediate vicinity. However, such charges may cause inconvenience, slow up production, or result in an inferior product. In flat-bed printing press work, for example, unless means are provided to prevent

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This article was presented as a paper at the 38th Annual Meeting of the National Fire Protection Association, Atlantic City, May 14-17, 1934. For discussion see Proceedings (printed as Part 2 of this QUARTERLY), page 172. The author is Electrical Engineer, Inspection Department, Associated Factory Mutual Fire Insurance Companies.

Static electricity, generated when a gasoline tank was being drained, is thought to have been responsible for this destructive fire at the Chicago Municipal Airport in 1930.

it, static electricity would often cause the sheets of paper to adhere to parts of the press and to cling together, and in some processes of the textile industry it would cause poor quality yarns. Sometimes small static charges, which are not a fire hazard themselves, may indirectly result in fire by causing finely divided stock to adhere to parts of a machine to such an extent that clogging and mechanical friction result. Such an effect has been found in cotton gins.

Static electricity is also generated when liquids flow through pipes and when liquids are broken up into drops. The charges are usually neutralized or conducted to earth as fast as they are generated unless the liquids have a very high electrical resistance. The resistance of some liquids, such as water, alcohol, fusel oil, and glycerine, even though considered high in the ordinary sense, is sufficiently low to prevent dangerous accumulations of static charges by carrying them away as fast as formed, either over surfaces wet with the liquids or through the liquids themselves. On the other hand some so-called dry liquids, such as gasoline, benzol, ether, and carbon bisulphide, have very high electrical resistances and frequently allow dangerous accumulations of static charges in processes and on machines in which they are used.

If a liquid having a high electrical resistance is discharged in the form of drops or spray into a closed metal tank insulated from ground, the entire tank will be charged. There is a real hazard in discharging flammable liquids,

particularly those of high electrical resistance and low flash point, into the tops of tanks. Under these conditions the filling pipe should always be carried down close to the bottom of the tank. In one case some rather heavy oil was pumped into a steel tank 20 ft. high and 15 ft. in diameter at a temperature of 140° F. The oil was allowed to flow from the open end of a 2-in. grounded iron pipe at the top of the tank into a basket strainer which was attached to the tank with iron supports. The oil dropped through the air in the tank for a distance of 20 ft. or less, depending on the level of the oil.

On days when the relative humidity was low, very high static charges collected on the surface of the oil and discharged from time to time to the tank. Some of the discharges were 4 ft. long and were accompanied by sharp reports.

Although there was little fire hazard because of the high flash point of the oil, it was thought best to eliminate the static discharges. First, a metal chain was suspended from the strainer and then metal baffles were installed to direct the oil against the side of the tank, but both of these changes failed to eliminate the trouble. The desired result was finally accomplished by attaching a sheet-iron funnel to the under side of the strainer and causing the oil to flow in a metal spout from the funnel to a point within a few inches of the bottom of the tank.

Gases in motion may generate static electricity, but ordinarily appreciable charges are not apparent unless there are solid particles or drops of liquid in the gas. One observer states that the discharge of carbon dioxide gas from a cylinder caused no static electricity unless the cylinder was inverted and liquid or solid carbon dioxide was mixed with the gas. Sparks about three inches long jumped from carbon dioxide cylinders that were insulated from ground while being discharged in this way.

Methods of Preventing Accumulations of Static Electricity.

Grounding.

It is impossible to prevent the *generation* of static electricity in industrial operations, but it can be neutralized or conducted to ground harmlessly as fast as generated. If the objects on which the charges collect are good electrical conductors they can be kept at earth potential by means of ground wires connected to water pipes, driven ground rods, etc., but if charges collect on non-conducting materials ordinary methods of grounding are not effective and they cannot be completely discharged unless contact is made with the entire surface. Bronze chains or brushes so arranged as to make contact with moving fabrics, etc., are used in some cases, but may not be completely successful in discharging all static electricity.

Charges of static electricity are not always confined to machines, fabrics, belts, etc., but are frequently found on the human body, especially at times of low humidity. These charges may be generated by the clothes, by the

Factory Mutual Record.

This detached building housed a balata purification process using gasoline in large quantities. Vapors escaping into the room formed an explosive mixture with air and were ignited either by a static spark from belts or a mechanical spark.

rubbing of the soles of the shoes on non-conducting floor coverings, or by various industrial operations. The human body itself is a very good conductor of static electricity and the charges are usually dissipated by contacts with other objects through shoes and clothing which are ordinarily moist enough to transmit them as fast as generated. However, this may not be true in very dry locations or where the generation of static electricity is especially rapid.

Several years ago painters who were at work renovating a small room in a factory were using paint remover which contained flammable solvents. They had neglected to open the door or windows to ventilate the room, and just after the paint remover had been applied for the second time in one corner of the room, a static spark from one of the painters' hands ignited the vapors. There was only a local explosive mixture of vapor and air in the room, but the rapid combustion increased the pressure, thus preventing the immediate escape of the painters through the door, which opened inward. Two sprinklers operated soon afterward, however, and cooled the gases, thus making it possible for the men to open the door and escape.

Some method of grounding the workers themselves has been found necessary in many hazardous locations where gasoline and similar flammable solvents are used. Where rubber cement is applied by hand to small parts resting on tables, it may be sufficient to provide the tables with grounded metal tops, but in other cases grounded metal floor plates are also necessary.

Both the floor and table coverings should be of non-ferrous metals to prevent mechanical sparks. The employees should not be allowed to wear rubber-soled shoes, and in especially hazardous locations it is often desirable for employees to wear "safety shoes" having fine copper or brass wire sewed through the soles or having brass nails in both heel and sole. Care must be taken, however, not to allow the soles of shoes or metal floor plates to become covered with rubber cement or other insulating substances.

Some people have an especially dry skin, with low rate of evaporation of body moisture. They accumulate static electricity more rapidly than others as there is less tendency to discharge it through the clothing to ground. An example of this effect was found in a shoe manufacturing plant, where one of the women employees fed leather soles into a machine which coated them with rubber cement. On five different occasions a spark from her fingers ignited the gasoline vapors from the cement. After one of the fires, in which she had been severely burned, she was under medical care for three weeks, and during her absence another girl operated the same machine without causing a single fire. When the first operator returned she had been at work for only fifteen minutes when the cement was ignited again. She was assigned to other work and there were no more fires at this machine.

There was a somewhat similar case in an automobile tire factory in Canada. One of the workmen found that he became charged with static electricity very frequently and he was in the habit of teasing his fellow workers by allowing sparks to jump from his fingers to their ears. This man was pushing a truck loaded with tire fabric near a tank of rubber cement when a spark jumped from him to the tank, setting fire to the gasoline vapors.

At another plant a fire was caused by a static electric spark which jumped from the fingers of the paymaster as he was handing a pay envelope to the operator of a machine using rubber cement.

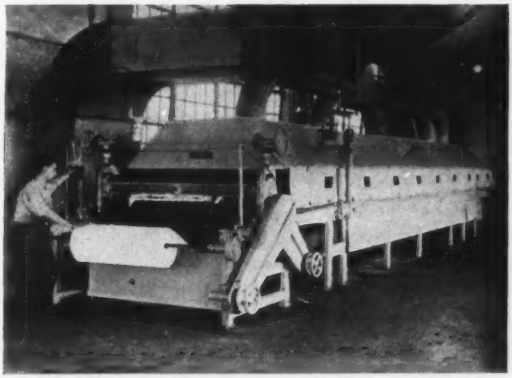
Humidity.

It has been found that most of the fires which are caused by static electricity occur during the winter months when artificial heating is required and the indoor humidity is low. If air at a temperature of 32° F. and relative humidity of 50% is heated to a temperature of 70° F. and no moisture is added, the relative humidity will be about 13% and it would be necessary to evaporate a little more than six gallons of water to increase the relative humidity from 13% to 50% in a room 100 ft. square and 12 ft. high, for example.

The average relative humidity for outdoor air at Boston, Massachusetts, for a period of a year was obtained from the weather bureau. From these figures the relative indoor humidity which would be obtained by heating the air to 60° F. in the winter months without artificial humidification was computed and is shown on page 24. In December, January, February and March

the inside relative humidity is 30% or less. Under these abnormally dry conditions static electricity which is generated in many industrial processes may accumulate in dangerous quantities, while under normal humidity conditions a thin film of moisture exists on most substances, which greatly reduces the electrical resistance and allows the charges to be neutralized or conducted to earth as fast as generated.

In some experiments made by the United States Bureau of Standards in 1915 it was shown that the surface conductivity of most materials changes through wide limits when the humidity is varied. The surface conductivity of plate glass, for example, at 70% relative humidity is one million times that at 20%, at 50% humidity it is about one thousand times, and at 40% about one hundred times that at 20% humidity. The increase in conductivity is due to the condensation of moisture on the surface of the material. Artificial humid-



Factory Mutual Record.

The maintenance of at least 40 per cent relative humidity is important to prevent static sparks at rubber coating machines.

ification of hazardous locations is, therefore, a very good method of preventing dangerous accumulations of static electricity, but in some cases it may be injurious to the product. The amount of humidification required to remove the charges from various substances has not been determined, but experience has shown that a combination of thorough grounding and a minimum relative humidity of at least 40% will usually prevent fires from static electric discharges. It should be kept in mind, however, that some processes include heaters or dryers for the rapid evaporation of solvents, and while the general humidity in the room may be 40 or 50%, it may be dangerously low, say 20% or less, in the vicinity of the heaters.

About ten years ago 122 fires occurred in the spreader room of a certain rubber factory in a period of three years. Static electricity was suggested as the cause of these fires and artificial humidification was recommended. During

the latter part of the three-year period, records of the relative humidity were kept and it was found that out of about 100 fires only one occurred at a relative humidity above 37%. After this, steam was allowed to escape into the air whenever the natural humidity fell below 40%, and a relative humidity between 40 and 50% was maintained. Only a few fires have been caused by static electricity in this rubber spreader room since that time.

Humidity has another effect in preventing fires in the textile industry in addition to that of preventing accumulations of static electricity. The amount of moisture in combustible materials is an important factor in determining whether they will be ignited by static sparks. It has been determined experimentally that it is much more difficult to ignite cotton which has been kept for some time in a room at 60% relative humidity, or higher, than that which has been kept in a room at a relative humidity of 30% or less.

Ionization.

Air is ordinarily a non-conductor of electricity, but when ionized it has sufficient conductivity to prevent the accumulation of static charges. Ionization by gas flames has been employed in the printing industry for many years. The sheets of paper are passed through gas flames as they leave the presses and all static charges are conducted to ground. Obviously this method is limited in application and cannot be used where flammable inks are employed, or in any hazardous location.

Another method of ionization is by means of silent, high potential electrical discharges produced by "static neutralizers." A high voltage transformer of small capacity is used to supply a high alternating potential to discharge units which may be mounted on printing presses, rubber spreaders, etc. The silent discharges ionize the air and increase its electrical conductivity so that the static charges are dissipated or conducted to the grounded framework of the machine. It should be borne in mind, however, that such electrical apparatus may be a source of fire itself unless properly installed and maintained.

Belts.

Belts accumulate high static charges and being of non-conducting material they cannot easily be kept at ground potential. Grounding the driving and driven pulleys is not sufficient and the installation of a grounded idler pulley does not accomplish the desired result.

Three ways of preventing dangerous charges on belts have been suggested: (1) Applying a dressing to the belt, which makes the surface a sufficiently good conductor of electricity to allow the immediate neutralization of static charges; (2) installing a network of grounded wires parallel to and about ¾-in. from the belt on both sides, and, (3) providing two grounded metal combs rubbing on the belt near the points where it leaves the two pulleys.

The first method mentioned above has some merit, but the effect of the dressing is not permanent and it must be applied repeatedly. Formulas for

A home-made tank truck, lacking ground connections, and makeshift tank-filling connections in a garage were responsible for this fire. The direct cause of the fire was the ignition of gasoline vapor by a static spark. The spark may have been from static electricity accumulated on the tank truck and not removed by any grounding facilities, or from static electricity generated during the flow of gasoline.

dressings having low electrical resistance for both leather and rubber belts have been prepared by the Bureau of Chemistry, United States Department of Agriculture. The second method, while effective electrically, is not good mechanically. In many locations it would be difficult to maintain the network of wires, and, if broken, they would undoubtedly increase the fire hazard. The third method is probably the most satisfactory where high speed leather or rubber belts are used in hazardous locations. Care must be taken that the metal combs and their ground wires are maintained in proper condition and that the combs are kept either in contact with the belt or very close to it, or sparks will jump between them.

Because of the possibility of broken ground wires and worn combs, it is preferable to eliminate belts from especially hazardous places and use direct drives by means of shafts extending through the wall from another room, or to use link belts, silent metal chains, or metal gears. If these drives cannot be adapted to the work and belts are found to be necessary, it is advisable, as an extra precaution, to limit the belt speed to 150 ft. per minute, where possible, to reduce the generation of static electricity.

The United States Department of Agriculture has found potentials of 65,000 volts on belt drives of threshing machines in the Pacific Northwest, and in another series of tests a maximum of 75,000 volts was recorded on a 22-in. leather belt in a grain mill.

Printing Presses.

The method commonly used to neutralize static electricity on printing presses using non-flammable inks has already been mentioned. Special precautions, in addition to the grounding of frames and the use of artificial

humidification, are required on rotogravure presses. The ink is thinned with naphtha and the presses contain from one to four ink fountains, each holding between 40 and 100 gallons of ink. These presses develop high charges of static electricity which, if not removed, produce sparks which may ignite the naphtha vapors. Ample ventilation is, of course, one of the most important safeguards, but static neutralizers or grounded bronze static-collecting brushes, or combinations of the two methods, should also be used to remove the charges from the paper.

Tests for Static Electricity.

Although dangerous accumulations of flammable gases, vapors, and dusts should be prevented by the use of exhaust systems and proper ventilation, it is advisable to make tests for static electricity in places where such flammable materials exist. However, tests made at high or even average humidity conditions are not conclusive, and if the results are negative the tests should be repeated at times of low humidity.

One simple way to determine the presence of static charges is to hold cotton or worsted fibres near the device to be tested. If an appreciable electric charge is present the fibres will repel each other. The most satisfactory instrument for detecting the presence of static electricity in manufacturing plants is the "Neon tester," used to test automobile spark plugs. This device consists of a small glass tube containing rarefied Neon gas which, together with a small condenser, is secured in a holder of insulating material. When brought near an object charged with static electricity a reddish glow occurs in the tube. Other instruments which have been used for such tests are the static voltmeter and gold-leaf electroscope. The static voltmeter will measure the voltage of a charge as well as indicate its presence, but both of these instruments are very delicate and not well adapted for general use in a manufacturing plant.

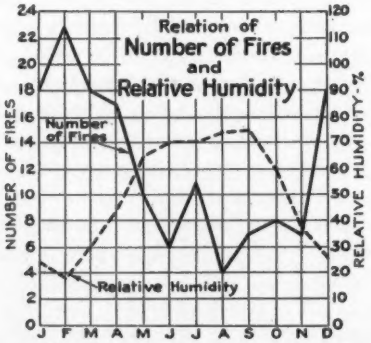


Chart showing relation of humidity to the number of fires attributed to static electricity. Fewer fires are noted when the relative humidity is high.

Fire Record.

The records of the Associated Factory Mutual Fire Insurance Companies show 147 fires in which static electricity was reported as the cause during the past six years. The majority of these fires occurred during the months of December, January, February, March, and April, the months when artificial heating is required and the relative humidity indoors is low. These fires have been plotted by months and the result is shown in the accompanying chart. By comparing this curve with that of the relative humidity the effect of humidity can be plainly seen.

An analysis of these fires shows that in 94% of them vapors from volatile flammable liquids were ignited by the static sparks, while in the remaining 6% combustible dust and lint were ignited. A further analysis of the flammable liquid fires shows that 39% occurred in rubber spreaders and other processes in which rubber cement was used, 25% in other spreading and coating processes, 14% in cleaning operations, 7% on printing presses, and 9% in miscellaneous operations in which flammable solvents were employed.

Considering the number of industrial operations in which volatile flammable liquids are used and the many ways in which static electricity is generated, it is interesting to note that during the period covered by the above analysis less than 1½% of all the fires reported were due to static electricity. This is encouraging because it indicates that the hazards are well recognized and that favorable results are being obtained from the use of the various safeguards, such as ample ventilation, grounding, artificial humidification, and static neutralizers.

The 1933 Fire Loss.

Fire losses for the United States for the year 1933 as estimated by the National Board of Fire Underwriters were $269,778,480, the smallest since 1916, and a decrease of $131,081,074, or 32.7 per cent, from 1932. This loss figure, determined since the publication of the April QUARTERLY, is approximately 15.9 per cent less than the preliminary estimate of the National Board of Fire Underwriters which appeared in that issue (see QUARTERLY, April, 1934, page 295).

The following tables give the annual fire loss in the United States for fifty-nine years and a comparison of losses on a per capita basis for the past ten years. In addition, there have been included tables showing the per capita losses of all cities of 100,000 population or over for a five-year period, and a tabulation of all cities of 20,000 population or over where the per capita fire loss exceeded five dollars during the past year. This latter group was reduced from a total of sixty-four cities in 1930 to forty-seven in 1931, to thirty-four in 1932, and dropped to ten in 1933, which may be considered an encouraging indication of results obtainable from improved fire fighting facilities and persistent fire prevention work.

Annual Fire Losses in the United States for Fifty-nine Years.

Year	Property Loss	Year	Property Loss	Year	Property Loss
1875	$78,102,285	1895	$142,110,233	1915	$172,033,200
1876	64,630,600	1896	118,737,420	1916	258,377,952
1877	68,265,800	1897	116,354,575	1917	289,535,050
1878	64,315,900	1898	130,593,905	1918	353,878,876
1879	77,703,700	1899	153,597,830	1919	320,540,399
1880	74,643,400	1900	160,929,805	1920	447,886,677
1881	81,280,900	1901	165,817,810	1921	495,406,012
1882	84,505,024	1902	161,078,040	1922	506,541,001
1883	100,149,228	1903	145,302,155	1923	535,372,782
1884	110,008,611	1904	229,198,050	1924	549,062,124
1885	102,818,796	1905	165,221,650	1925	559,418,184
1886	104,924,750	1906	518,611,800	1926	561,980,751
1887	120,283,055	1907	215,084,709	1927	472,933,969
1888	110,885,665	1908	217,885,850	1928	464,607,102
1889	123,046,833	1909	188,705,150	1929	459,445,778
1890	108,993,792	1910	214,003,300	1930	501,980,624
1891	143,764,967	1911	217,004,575	1931	451,643,866
1892	151,516,098	1912	206,438,900	1932	400,859,554
1893	167,544,370	1913	203,763,550	1933	269,778,480
1894	140,006,484	1914	221,439,350		

NOTE:—Previous to 1916 figures obtained from the records of the New York *Journal of Commerce*, deducting the Canadian losses. Subsequent years are based on returns to Actuarial Bureau of the National Board of Fire Underwriters, adding 25% for unreported and uninsured losses. The figure for 1933 is based on estimates made by the Actuarial Bureau.

Comparative U. S. Fire Losses.

	Whole Country			Cities of 20,000 Population and Over		
	Population	Total Loss	Per Capita	Population	Total Loss	Per Capita
1924.....	112,078,611	$549,062,124*	$4.90	43,375,796	$146,222,749†	$3.37
1925.....	115,378,094	559,418,184	4.85	45,297,469	160,011,951	3.53
1926.....	117,136,000	561,980,751	4.80	53,243,778	178,178,874	3.35
1927.....	119,320,000	472,933,969	3.96	51,291,549	144,618,641	2.82
1928.....	120,013,000	464,607,102	3.87	51,836,000	140,038,116	2.70
1929.....	120,700,000	459,445,778	3.81	53,411,000	145,059,043	2.72
1930.....	122,775,046	501,980,624	4.09	50,206,000	150,981,223	3.01
1931.....	124,070,000	451,643,866	3.64	51,084,000	125,933,681	2.47
1932.....	124,822,000	400,859,554	3.21	51,295,000	113,947,789	2.22
1933.....	125,693,000	269,778,480	2.15	51,553,000	77,686,291	1.51

*Estimated from Records of the Actuarial Bureau. †Figures reported by fire departments.

Losses in Cities of 20,000 Population or Over.

Losses in cities of 20,000 population and over as reported by the fire department officials show a drop of 32% from 1932, which continues a trend, first apparent in 1932, of a decline in city losses at a slightly lesser rate than the country as a whole. These large city losses comprise but 28.8% of the total loss for the country, indicating that the high level of destruction still remains in the smaller communities and rural districts rather than in the large urban centers. This is also indicated by the per capita loss for the country as a whole of $2.15 as compared with but $1.51 average for the 461 cities of 20,000 population or over.

Per Capita Fire Losses of Cities Over 500,000 Population.

	Population	1929	1930	1931	1932	1933	Five-Year Average
New York, N. Y.*.....	7,346,000	$3.54	$3.47	$3.24	$3.38	$1.88	$3.10
Chicago, Ill.....	3,475,000	4.75	4.48	2.73	3.42	1.64	3.40
Philadelphia, Pa.....	1,951,000	2.86	2.72	2.12	2.09	1.19	2.20
Detroit, Mich.....	1,383,000	2.64	2.74	2.30	1.82	1.37	2.17
Los Angeles, Cal.....	1,275,000	2.98	1.27	1.82	1.14	.85	1.61
Cleveland, O.....	900,000	3.42	4.26	2.61	2.26	.94	2.70
Baltimore, Md.....	827,000	1.87	2.84	1.53	3.29	1.68	2.24
St. Louis, Mo.....	821,000	2.41	2.58	1.77	1.67	1.70	2.03
Boston, Mass.....	805,000	5.30	6.54	5.14	5.27	2.93	5.04
Pittsburgh, Pa.....	700,000	2.18	1.69	1.61	1.25	.64	1.47
San Francisco, Cal.†.....	689,000	...	...	...	...	...	...
Milwaukee, Wis.....	612,000	2.39	2.83	1.60	1.23	2.23	2.06
Buffalo, N. Y.....	573,000	4.47	2.00	2.20**	2.17	1.69	2.51

†Does not report its losses.

*These figures are based on losses paid in New York City by the subscribers to the Actuarial Bureau of the National Board of Fire Underwriters. The fire department estimates for these years were considerably lower.

**Incomplete. Does not include Buffalo Armory fire, involving loss of at least $2,500,000.

Cities from 400,000 to 500,000 Population.

	Population	1929	1930	1931	1932	1933	Five-Year Average
Washington, D. C.	495,000	$2.37	$2.59	$ .75	$ .72	$ .80	$1.45
New Orleans, La.	472,000	1.54	1.57†	1.42	1.47	.92	1.38
Minneapolis, Minn.	489,000	2.71	3.25	3.06	2.33	2.35	2.74
Cincinnati, O.	464,000	2.04	1.74	1.89	1.37	1.30	1.67
Newark, N. J.	444,000	3.01	3.62	2.82	2.14	1.38	2.59
Kansas City, Mo.	424,000	3.84	3.69	2.71	4.05	1.72	3.20

Cities from 300,000 to 400,000 Population.

Seattle, Wash.	390,000	$2.73	$2.14	$2.94	$2.38	$1.16	$2.27
Indianapolis, Ind.	375,000	3.66	2.66	1.44	1.19	1.02	1.99
Rochester, N. Y.	350,000	1.83	1.67	1.65	1.26	1.63	1.61
Jersey City, N. J.	325,000	.54	2.26	1.14	.53	.42	.98
Portland, Ore.	310,000	2.85	2.55	3.04	2.21	2.14	2.56
Louisville, Ky.	308,000	2.52	4.33	3.19	1.53	1.93	2.70
Columbus, Ohio	300,000	1.22	1.22	.40	.65	.39	.78
Denver, Col.	300,000	2.06	1.84	1.25	2.18	1.00	1.67
Houston, Tex.	300,000	2.69	3.05	3.43	4.86	2.39	3.29

Cities from 200,000 to 300,000 Population.

Toledo, O.	291,000	$3.61	$2.98	$3.70	$2.06	$1.10	$2.69
Oakland, Cal.	284,000	1.58	2.65	2.83	1.44	1.39	1.98
St. Paul, Minn.	283,000	3.39	3.68	2.70	2.67	1.93	2.27
Dallas, Tex.	277,000	5.62	6.66	5.59	4.47	3.18	5.10
Atlanta, Ga.	277,000	2.69	6.73	2.48	1.38	2.17	3.09
Birmingham, Ala.	260,000	3.26	2.11	3.09	1.93	1.28	2.33
Memphis, Tenn.	260,000	3.08	5.54	4.03	3.19	2.35	3.84
Providence, R. I.	253,000	3.74	2.86	3.63	1.39	.66	2.46
Akron, O.	250,000	2.26	1.64	1.18	.84	.91	1.37
San Antonio, Tex.	233,000	.68	.94	1.05	1.44	.64	.95
Omaha, Neb.	225,000	5.42	2.07	2.56	2.87	3.77	3.34
Syracuse, N. Y.	210,000	1.58	2.39	2.50	2.49	1.48	2.09
Dayton, O.	201,000	1.04	1.07	1.07	1.73	2.33	1.45

Cities from 150,000 to 200,000 Population.

Worcester, Mass.	195,000	$5.38	$3.69	$5.14	$4.62	$1.66	$4.50
Richmond, Va.	186,000	2.01	.83	1.24	.65	1.28	1.20
Oklahoma City, Okla.	183,000	3.56	3.12	1.15	.77	.38	1.80
Youngstown, O.	170,000	2.18	3.05	1.64	.89	.47	1.65
Fort Worth, Tex.	170,000	9.64	5.58	6.55	3.96	2.92	5.73
Grand Rapids, Mich.	169,000	1.11	1.00	2.05	.67	.88	1.34
Hartford, Conn.	164,000	2.35	3.12	1.87	1.99	.68	2.00
New Haven, Conn.	163,000	3.29	2.78	2.47	1.86	1.75	2.43
San Diego, Calif.	160,000	.60	1.13	.57	.96	.70	.79
Nashville, Tenn.	160,000	8.11	5.89	4.55	4.98	3.96	5.50
Flint, Mich.	156,000	1.46	2.25	.89	1.17	.96	1.35
Springfield, Mass.	150,000	2.17	2.15	3.20	4.14	1.57	2.65

†The New Orleans per capita loss figure for 1930 obviously does not include the two wharf fires which occurred during March, 1930, with a total loss of approximately $4,000,000.

Cities from 125,000 to 150,000 Population.

	Population	1929	1930	1931	1932	1933	Five-Year Average
Bridgeport, Conn.	147,000	$ .87	$ .74	$1.05	$1.98	$ .47	$1.02
Des Moines, Iowa	143,000	5.56	5.03	1.50	1.42	1.41	2.98
Scranton, Pa.	143,000	3.66	2.71	2.10	2.84	1.76	2.41
Long Beach, Cal.	143,000	.72	1.19	1.11	.43	.91	.87
Tulsa, Okla.	142,000	.92	1.24	.87	.84	.84	.94
Salt Lake City, Utah	140,000	1.64	2.90	3.07	1.52	1.73	1.97
Paterson, N. J.	138,000	4.83	8.99	3.50	2.41	1.83	4.31
Yonkers, N. Y.	138,000	2.26	1.78	2.18	1.68	1.72	1.92
Jacksonville, Fla.	135,000	1.57	3.23	8.64	4.21	2.73	4.08
Norfolk, Va.	130,000	3.17	3.11	9.09	3.12	2.42	4.18
Albany, N. Y.	127,000	3.20	2.56	4.24	1.73	1.69	2.68
Kansas City, Kans.	125,000	1.47	1.00	.86	2.69	.68	1.34

Cities from 100,000 to 125,000 Population.

Trenton, N. J.	123,000	$2.36	$1.77	$2.70	$1.12	$2.04	$2.00
Chattanooga, Tenn.	120,000	2.21	8.57	2.91	1.27	2.63	3.52
Elizabeth, N. J.	120,000	3.73	2.79	1.83	2.22	1.19	2.35
Camden, N. J.	119,000	...	...	...	1.86	1.68	1.77
Erie, Pa.	117,000	.70	1.08	1.78	1.86	.68	1.22
Spokane, Wash.	116,000	6.71	2.32	2.55	1.74	2.21	3.11
Fort Wayne, Ind.	116,000	2.31	2.16	1.56	1.02	.69	1.55
Fall River, Mass.	115,000	1.37	1.60	1.69	2.36	2.16	1.84
Peoria, Ill.	115,000	3.58	2.50	2.34	3.29	.89	2.52
Cambridge, Mass.	114,000	3.61	7.57	4.14	3.57	1.29	4.04
Reading, Pa.	113,000	4.65	2.58	3.67	.76	1.10	2.55
New Bedford, Mass.	111,000	1.16	1.77	1.50	.87	.83	1.23
Wichita, Kans.	111,000	2.55	.68	.76	1.13	.95	1.21
Miami, Fla.	110,000	1.21	.94	1.20	1.28	.75	1.08
Tampa, Fla.	108,000	2.75	1.51	2.32	1.94	.87	1.88
Tacoma, Wash.	107,000	2.19	6.09	2.93	2.51	1.85	3.11
Wilmington, Del.	107,000	1.59	.89	2.35	2.01	2.37	1.84
Knoxville, Tenn.	106,000	1.34	3.57	1.29	1.18	.66	1.61
Canton, O.	104,000	1.96	2.59	1.12	.97	.57	1.44
South Bend, Ind.	104,000	2.95	1.81	.91	1.20	.75	1.52
Somerville, Mass.	104,000	2.25	3.86	2.81	2.54	2.40	2.77
Utica, N. Y.	104,000	4.16	4.86	6.59	4.09	1.84	4.31
Lynn, Mass.	103,000	3.94	3.89	4.52	4.71	2.85	3.98
Evansville, Ind.	103,000	1.57	5.68	1.76	1.97	1.13	2.42
El Paso, Tex.	103,000	3.49	1.18	3.76	1.02	.50	1.99
Lowell, Mass.	102,000	1.99	2.80	2.41	2.46	2.08	2.35
Duluth, Minn.	101,000	3.78	4.61	3.66	3.48	2.01	3.51
Waterbury, Conn.	100,000	2.59	1.78	2.15	2.33	1.98	2.17
Gary, Ind.	100,000	2.22	3.66	2.64	3.54	.61	2.53
Allentown, Pa.	100,000	.50	1.05	.33	5.33	1.52	1.75

Cities in Which Loss Exceeded $5.00 Per Capita in 1933.

Barberton, Ohio	$9.21	Huntington Park, Calif.	$5.35
Charleston, S. C.	7.54	Fresno, Calif.	5.26
Lewiston, Me.	6.25	Casper, Wyo.	5.16
***Burlington, Vt.	5.63	***Gloversville, N. Y.	5.04
****Peabody, Mass.	5.37	Marshalltown, Iowa.	5.01

NOTE:—Asterisks indicate the number of years in which the city has been in this class during the five-year period ending December 31, 1933.

Losses Lower for First Part of 1934.

The fire losses for the United States for the first five months of 1934 were $138,058,828, which is $21,632,150, or 13.5% less than for the same period last year, according to the estimates prepared by the National Board of Fire Underwriters. The losses for May this year were, however, nearly a million dollars above those for the same month last year.

	1930	1931	1932	1933	1934
January	$42,344,035	$44,090,449	$39,224,783	$35,547,565	$28,002,583
February	43,206,940	41,776,051	39,824,622	36,661,481	31,443,484
March	42,964,392	44,074,362	49,189,124	35,321,248	31,312,359
April	43,550,996	41,423,764	43,822,233	27,825,970	22,028,943
May	38,415,142	37,835,273	39,270,524	24,338,714	25,271,459
Total—5 months	$210,481,505	$209,199,869	$211,331,286	$159,694,978	$138,058,828

Canadian Fire Losses, 1933.

Canadian fire losses for the year 1933 amounted to $32,676,314, sustained in 46,166 fires, according to statistics furnished by J. Grove Smith, Dominion Fire Commissioner. These figures show an even more marked reduction in losses than was experienced for the year before. The reduction in the amount of property loss amounted to $9,517,501, or 22.6% less than the 1932 loss, which was in turn 10.4% less than the loss for the previous year. The number of fires reported was 1687 less than for 1932.

This very considerable reduction in fires and losses is due to the general depreciation of property values, including a smaller volume of values at stake in mercantile buildings, and an almost unprecedented freedom from large fires in the Dominion.

A Decade of Fire Losses in Canada.

Year	Property Loss	Per Capita	Year	Property Loss	Per Capita
1924	$45,906,500	$4.99	1929	$47,499,746	$4.85
1925	40,729,724	4.35	1930	46,109,875	4.70
1926	38,295,096	4.15	1931	47,117,334	4.54
1927	32,254,084	3.29	1932	42,193,815	4.06
1928	36,402,018	3.79	1933	32,676,314	3.15

Losses by Provinces.

	Population	Loss, 1932	Per Capita Loss, 1932	Loss, 1933	Per Capita Loss, 1933
Alberta	731,605	$2,376,658	$3.24	$1,435,612	$1.96
British Columbia	694,263	3,299,005	4.75	1,852,253	2.66
Manitoba	700,139	1,585,906	2.26	1,146,000	1.64
New Brunswick	408,219	1,507,805	3.69	2,188,200	5.37
Nova Scotia	512,846	1,687,459	3.29	1,779,614	3.47
Ontario	3,431,683	15,466,070	4.56	11,250,182	3.27
Prince Edward Island	88,038	615,047	6.98	272,696	3.09
Quebec	2,874,255	13,911,715	4.84	10,862,250	3.76
Saskatchewan	921,785	1,673,741	1.82	1,869,903	1.71
Not reported	.....	70,409	...	19,604	...
Total	10,374,196	$42,193,815	$4.06	$32,676,314	$3.15

Wooden Shingle Roofs.

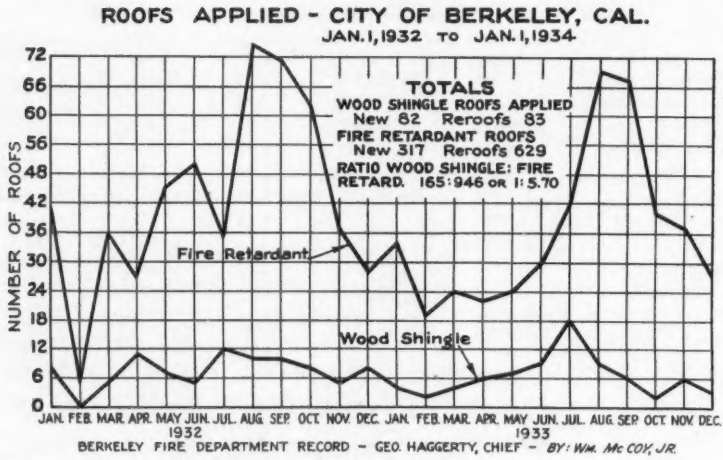
Some New Light on an Old Hazard.

Two interesting comments on the wooden shingle roof as a fire hazard have recently been received. They both indicate that the wood shingle is fighting a losing battle as a popular roof covering, and also that the wood shingle is still giving gray hairs to the fire chiefs.

Berkeley, California.

The chart shown herewith was prepared by the fire department of Berkeley. It is concrete proof of the waning popularity of the wood shingle. Berkeley is a very interesting case. The great Berkeley conflagration occurred on September 17, 1923. The official report of the fire contained the following statement: "Of the 584 buildings totally destroyed, 540, or 92½ per cent, had roof coverings of wooden shingles. Of all the factors entering into the rapid spread of the conflagration, not excluding the high wind and the weak water system, this was of greatest weight. Had roofs been covered with fire-resistive material, the conflagration never would have attained serious proportions. Motion pictures taken during the fire show exactly how wooden shingles contributed to its spread. Under the influence of the high wind, burning shingles were carried from roofs of buildings already well involved by the fire and deposited on other shingle roofs, which in turn quickly burst into flames."

Within a month the City Council adopted an ordinance prohibiting wooden shingle roofs in Berkeley. But this was heresy. No other Pacific Coast city at that time had taken such action. Wooden shingles are made in large quantities in the Northwest. The lumbermen were up in arms and by the expenditure of great effort a petition for a referendum with signatures of 4717 residents of Berkeley, requesting the use of wooden shingles, was filed. In



a few months the ordinance was repealed. The wooden shingle manufacturers felt that they had won a great victory. But the property owners of Berkeley have apparently learned their lesson from the conflagration, as the chart shows.

During the period from January 1, 1929 to May 1, 1934, a total of 3519 fire-retardant roofs were applied, 1891 for re-roofing and 1628 new roofs. During the same period only 627 wooden shingle roofs were applied, 234 for re-roofing and 393 new roofs. Eight out of every nine persons who have re-roofed their homes in the past five years have used fire-retardant roofing in preference to wooden shingles.

In spite of this preference for fire-resistive roofing in Berkeley, it is interesting to note that the wood shingle remains, year after year, the principal cause of fires in the city. The annual city report for the fiscal year ending June 30, 1933, says: "The most important single cause of fires in Berkeley this year was shingle roofing, resulting in 177 fires. For this reason the fire department vigorously recommends that new roofs be constructed of non-inflammable material."

In his last annual report Fire Chief Haggerty says of wooden shingles: "As long as this menace to safety remains, Berkeley will always be in danger of a repetition of the conflagration of 1923. Surely an ounce of prevention here would be worth far in excess of the proverbial pound of cure." He recommends as of primary importance that steps be taken to furnish the people with an opportunity to again vote on the abolition of wooden shingles as a roof covering.

In spite of the increasing number of fire-resistive roofs, Berkeley has had over 600 wooden shingle roof fires in the last four years. No other cause of fires in the city remotely approaches this number.

Indianapolis, Indiana.

One of the most pithy expositions of the hazards of the wooden shingle roof is contained in the following letter written as a result of a request made to friends in Indianapolis to help in a campaign for an ordinance prohibiting wooden shingle roofs in Lexington, Kentucky:

The Indianapolis Salvage Corps
422 E. New York Street
Indianapolis, Ind.

April 25, 1934.

Lexington Board of Commerce,
Lexington, Ky.
Gentlemen:

Indianapolis enacted an Ordinance to Eliminate Wooden Shingle Roofs in 1920. While the Ordinance was pending in the Council one day we had 58 fires, 56 of which were from sparks on wooden shingle roofs, and next day the Ordinance was passed.

Our fire losses in dwellings at that time were about $300,000 each year, mostly caused by sparks on shingle roofs. We had each year about from 1200 to 1500 fires from sparks on shingle roofs. We have cut our losses on dwellings to less than $150,000, and the spark fires to less than 600. You could not give wooden shingles away to any person around Indianapolis, nor in any of the small cities outside of Indianapolis, which have no building laws, but are using fire-resisting shingles.

The Salvage Corps of all cities have to cover all roofs that have had fires on them, and this is no small job. In the city of Philadelphia, which has no wooden shingle roofs, the Salvage Corps uses about 110 roof covers each year, while in Indianapolis we use from 700 to 1200 roof covers each year.

Yours very truly,
W. J. CURRAN, Superintendent.

Indianapolis has gone a lot further in the elimination of the wooden shingle roof than Berkeley, but a striking confirmation of the current Berkeley experience is found also in the Indianapolis figures. In a recent study of the causes of fires during 1933 in Indianapolis, Fire Chief Voshell found that roof fires were the cause of about 25 per cent of the alarms, albeit somewhere between 90 and 95 per cent of the shingle roofs in the city have now been eliminated as a result of the campaign starting in 1920.

Water Supplies for Rural Fire Protection.

By P. C. Charnock,

New England Insurance Exchange (Member N.F.P.A.).

The providing of some supply of water for fire protection in communities which do not have a water system is not a difficult or expensive problem. In many of our States there are innumerable places where natural bodies of water for suction supply to pumpers can be made available through the medium of a reasonably small amount of labor. Unfortunately, many towns have not taken advantage of these natural resources for fire protection. As a matter of fact, a large number of people believe if water is in sight it can immediately be utilized as a supply to pumpers, even if the source is shallow or at some distance from the roadway. Too many cases of losses can be cited where fire departments have responded to fires in rural sections, and even on the outskirts of our cities, where ample quantities of water might have been obtained had there been a proper approach constructed, water impounded or a hole dug deep enough to permit the covering of the suction hose for a pumping engine. In spite of these experiences the time-worn saying seems to apply, that when it rains you cannot shingle the barn and when it does not rain it is not necessary to shingle it.

The storage of water for fire engine use is nothing new. Our colonial ancestors are recorded as far back as 1653 in a town meeting in Boston as voting to give permission to one William Franklin and others to construct a cistern for the purpose of providing fire protection. Many of our cities throughout the country depended on such cisterns for this purpose before water systems were built, and some cities have retained them up to recent years.

Massachusetts Plan for Water Hole Construction.

The unemployment situation has not been without some little compensation in regard to this type of fire protection in the State of Massachusetts, that is, through the aid of the Federal government and its agency, the Civil Works Administration. While money has been available throughout the entire country for labor in renovating fire stations, improvement of fire alarm systems, extensions of water mains and some minor improvements for fire protection, the rural or outlying sections in certain of the towns of the State of Massachusetts have benefited materially through the construction of numerous "water holes." This term may bring to your minds the days of your youth when, in the early spring, you played "hooky" to take a plunge

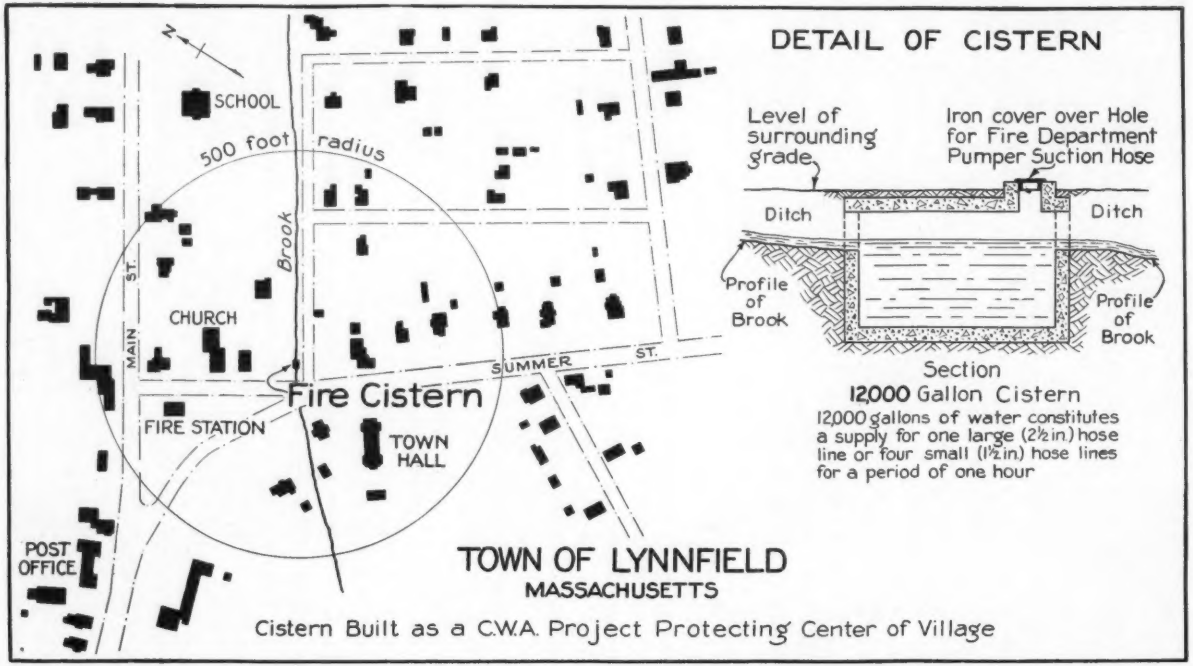
This article was presented as a paper at the 38th Annual Meeting of the National Fire Protection Association, Atlantic City, May 14-17, 1934. For discussion see Proceedings (printed as Part 2 of the QUARTERLY), page 210.

Rural pumper at Plympton, Mass., furnishing three 1½"-inch hose streams, taking suction from water hole. Water is obtained from a ditch extending to a near-by swamp.

in some stream for a swim or to try your luck at angling. In this case, it is used as describing a location where fire department pumpers may be used to draft water.

When the call was issued late in 1933 for suggestions for projects to be undertaken under the provisions of the CWA, the Massachusetts Safety Council, through one of its committees on fire prevention, submitted the proposal that an appropriation be made to construct suction supplies for pumpers so that properties located beyond the reach of public hydrants or in communities not having a water system might have some measure of fire protection. At first, the plan called for such a development throughout the State. The Civil Works Administrator, however, was willing to sanction this work only in five of the southeastern counties of the State, as it was felt the severity of the winter in the northern and western sections would not permit much outdoor work of this nature. Accordingly, an appropriation of $80,000 was allotted and later an additional appropriation was made, bringing the total amount to be expended to $115,000. As this was a State project it was necessary that it be under the direction of some State department. In this case, the Department of Agriculture was given jurisdiction and the Director of the department requested the Safety Council Committee to undertake the organization of the personnel necessary to start the project functioning.

The committee was very fortunate in obtaining the services of a technical graduate of considerable experience, who had been out of employment for some time, to act as supervisor for the State. Under his direction a corps of ten local supervisors and engineers, all trained executives, was quickly organized,


N
SCHOOL
500 foot radius
Brook
ST.
MAIN
CHURCH
SUMMER ST.
Fire Cistern
FIRE STATION
TOWN HALL
POST OFFICE
TOWN OF LYNNFIELD
MASSACHUSETTS
Cistern Built as a C.W.A. Project Protecting Center of Village
DETAIL OF CISTERN
Level of surrounding grade
Iron cover over Hole for Fire Department Pumper Suction Hose
Ditch
Ditch
Profile of Brook
Profile of Brook
Section
12,000 Gallon Cistern
12,000 gallons of water constitutes a supply for one large (2½ in.) hose line or four small (1½ in.) hose lines for a period of one hour

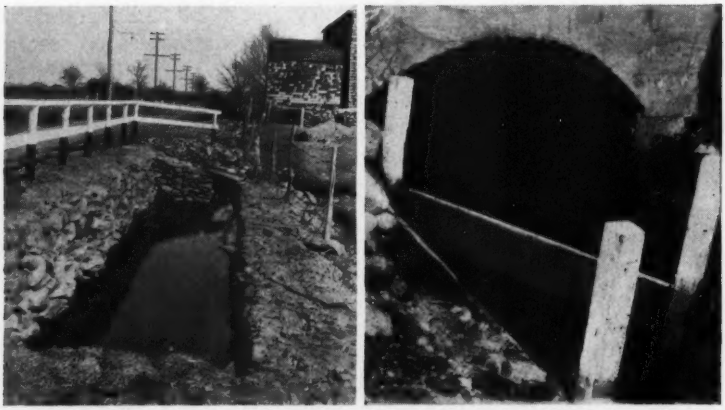
and within one week after the authorization was received the actual construction was started. The territory was arranged so that each supervisor and engineer had about six or seven towns to cover. Meetings were held in each of the districts and the fire chiefs and chairmen of Boards of Selectmen were given an explanation of the problem. In each town a crew of seven workmen and a foreman were selected from the unemployed men in that territory. In a number of instances the Chief of the Fire Department was selected as a foreman which, naturally, was of considerable benefit, as he was familiar with the topographical conditions and was desirous of obtaining new water supplies for fire protection. At the time the work was started it was almost impossible to buy tools in any quantity, as these had all been absorbed on other projects which had been started earlier, but through the assistance of the fire chiefs, tools were obtained from the fire departments or borrowed in the towns and used until such time as tools could be obtained elsewhere.

Many of the sites selected by the supervisor and engineer in the individual territories were located on private land and it was necessary to obtain releases from the owners. This did not present any serious difficulty. Many of the owners willingly donated stone walls, gravel, timber and even, in certain cases, provided cartage. A large majority of the men employed on this work were not found on the lists of the welfare departments of the towns, but were seriously in need of money. In general, the type of worker was above the average used for labor of this class. They all went about the work with the greatest enthusiasm.

Types of Water Sites.

There were three types of water sites constructed, the most common being what has been termed the "water hole," which would be a location adjacent to a road on a running brook or stream and, naturally, in the vicinity of a reasonable amount of property to be protected. Information was secured as to whether the stream had a flow during the entire year and if so, a basin was excavated on the bank of the brook. When this basin was completed an inlet from the stream was cut into the excavation, and where possible an outlet was made to provide circulation. Wherever material was available the sides of the hole were stoned, if not, old railroad ties were used or, as in some instances, the sides were sloped and heavily sodded. In selecting the sites consideration was given to the amount of property which might be protected within 1000 or 1200 feet of the location. The amount of storage in the basin ranged from 10,000 to 25,000 gallons capacity. If there was danger of children or animals falling into the water storage, fences were constructed around the location and where near schoolhouses the holes were covered with plank.

When running water was not available and if protection was needed in the vicinity of swampy land, a cofferdam of cedar trees was made and an



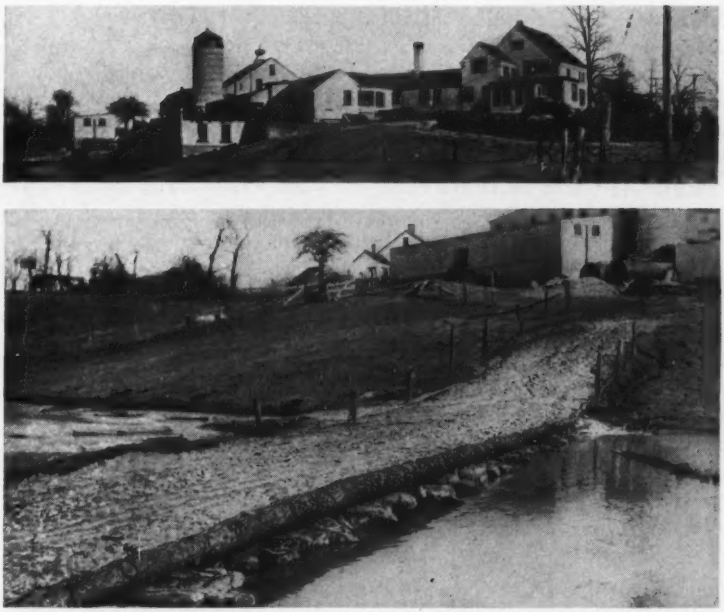
Two methods of water hole construction where running streams are adjacent to roads. Left: a stone lined suction basin filled by a small brook. Right: a wing dam in a fast flowing brook used to prevent the accumulation of silt and refuse in suction basin.

excavation constructed inside this dam. Trenches were then run into the swamp so as to drain into this hole. One storage of this type was made close to the center of a town which served all of the central buildings such as the Town Hall, school, churches, the fire station, as well as a large number of residences. In other places where the State had been engaged on mosquito control work adjacent to rivers, the drainage ditches were extended to the roadway where a barrel was submerged to act as a sump into which the suction hose of a pumping engine could be placed.

The men engaged on the work learned that a wing dam in a fast flowing brook would divert the silt and refuse from collecting in the holes which they had constructed; also that the straightening of the course of the brooks tended to lessen the danger of filling in the holes or the sumps.

In this territory there were a large number of ponds and small lakes, usually shallow at the shore line, which receded in dry seasons. In one town there are some 365 ponds or lakes, most of them having a considerable number of summer cottages near by. With proper approaches these ponds may be made available and unlimited quantities of water can be supplied for use in case of fire. Many of these ponds were utilized by the construction of approaches made by extending a jetty out from the shore so as to get the required depth of water for suction purposes during the dry season. Brush and trees were cut and used as a base for a corduroy road or approach to the jetty.

The third type of site, used only occasionally, was an underground concrete reservoir of about 25,000 gallons capacity. These were constructed in some of the more densely settled summer colonies where there was no immedi-



Property valued at $90,000 was saved at a fire in Falmouth, Mass., solely through use of water from a water hole which had been partially completed. Upper picture shows ruins of garage of large dairy farm (left), together with exposed buildings. Lower picture shows water supply and newly constructed approach for pumper.

ately available natural water supply. These, of course, required filling, and often surface water drainage could be diverted to keep these filled. This type of storage is more expensive than the open basin, but once constructed it requires little attention other than to maintain the water level and should prove to be of much value where a large number of properties can receive the benefit of this protection.

Results.

It should be borne in mind that money made available under the Civil Works Administration was practically all for labor, and where any great amount of material was required it was donated by individuals or by the towns in which the work was being done. In all, in a period of four months up to the last of April of this year, when the CWA projects were discontinued, some 500 sites, or an average of 8 in each town, had been completed in this territory. Only the surface has been scratched in these five counties; there are innumerable points still untouched where development could be continued.

Within a radius of about 1200 feet of these established sites, it is estimated that there are over 10,000 buildings which are protected to varying

degrees, depending upon their distance from the sites and the amount of water stored therein. It has been further estimated that, exclusive of contents, the building valuation coming under this protection is in excess of $17,000,000. The average cost of the sites constructed, exclusive of materials, was approximately $225 each.

The project certainly has fulfilled its object in providing useful work for those needing it at a time during the year when it would have been extremely difficult for these men to have eked out any kind of an existence. Aside from this, the water supplies made available have already proved of considerable value for use in the extinguishment of fires. Only two weeks after one hole was completed a fire occurred in a garage of a large dairy farm in the vicinity. This property consisted of nine closely grouped buildings having a valuation of about $90,000. At the time of the fire the temperature was below zero. Through the efforts of the fire department utilizing the impounded water, eight other buildings connected or adjacent to the garage were saved from destruction. These, undoubtedly, would have been consumed if the fire had occurred prior to the completion of the water storage. The loss in this case was about $15,000. From records available it is estimated that a total of $140,000 worth of property has been saved from destruction through the use of the "water holes" constructed under this project.

As the situation now stands this work has been discontinued, as under the Federal Emergency Relief Administration all projects are limited to cities and towns of over 5000 inhabitants and must be under the jurisdiction of a municipality, and not a State proposition as has been done up to the present time in many instances. Undoubtedly, many municipalities will make application for the extension of this work, as great publicity is being given to the value of the work already completed in the southeastern portion of Massachusetts. It is possible other States have been undertaking similar work, but we do not know of any up to the present time. It would seem, however, if relief is still necessary, that this is one of the most worthwhile projects which can be undertaken to make use of unemployed labor. Should the ERA decide not to continue or undertake any more of this work the experience and value of this project as so far demonstrated should be an incentive for adoption by the individual towns.

Fighting Oil Transformer Fires.*

By G. S. Diehl and W. T. Crook, Jr.

Though normally inert and harmless, every oil filled transformer and oil circuit breaker is a potential fire hazard. In addition to the probability of direct loss and damage to near-by equipment, fires in transformers and circuit breakers of this type may seriously interrupt service to customers, involving additional indirect losses of revenue.

In some instances such fires have gotten beyond control of station attendants and have practically destroyed the station itself. Outside help is usually late in arriving on the scene, and even then is not apt to be familiar with electrical hazards. In fighting any fire every minute of delay is serious, as the fire quickly becomes increasingly difficult to extinguish. For this reason fire fighting equipment must be available and the men trained in its use.

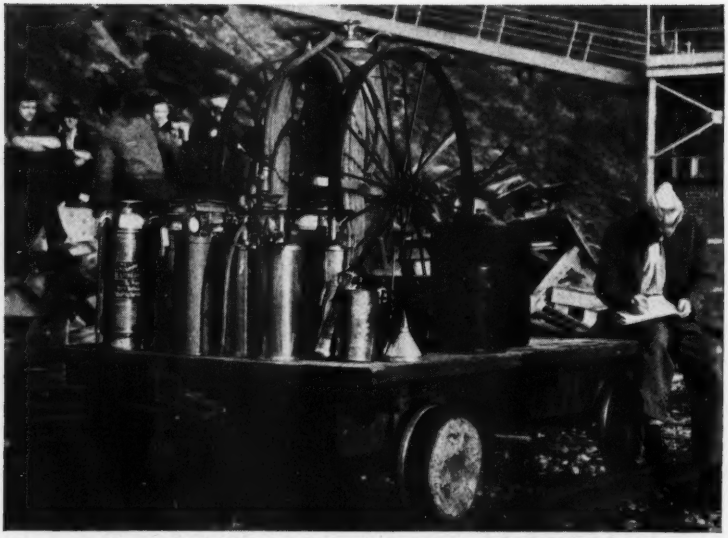
How can transformer and oil circuit breaker fires be extinguished in the quickest possible time? The solution lies in the selection of the proper extinguisher and its effective application. This paper presents methods and procedures which have efficiently extinguished such fires, which, it is hoped, will enable those who are interested to inaugurate or improve their protection against this class of fires.

Oil Transformer Fires.

The earlier designs of transformers had an air space between the top of the oil and the cover. A fire in this type is liable to develop into a seething caldron if not quickly extinguished. Later transformer designs made use of the conservator tank and the gas filled principle. If a fire develops in a conservator type, the hot oil will boil over, spread over the ground and so may carry the fire to adjacent equipment. In the event of trouble in a gas filled transformer, such as escaping gas, the ensuing fire may be of the caldron type. By locating large transformers out of doors, the fire hazard to other station equipment is practically eliminated provided that the distance from the building is sufficient.

A series of tests covering the extinguishment of fires in oil filled electrical equipment was conducted by the Pennsylvania Water and Power Co. and reported in the QUARTERLY of the National Fire Protection Association, October, 1921 (Vol. 15, No. 2, page 141). The tank used for these fire tests simulated a 10,000 kva., 70,000/11,000 volt (air space above oil type) trans-

*Extracted from a paper submitted in a contest under the auspices of the National Electric Light Association and Edison Electric Institute, and receiving the 1933 James H. McGraw second prize award. Mr. Diehl is assistant to the superintendent of operation, Pennsylvania Water and Power Company, and Mr. Crook is testing engineer of the Safe Harbor Water Power Corporation.



Fire extinguishing equipment used during practice tests.

former. The oil was heated to about 200° C., which was above the flash point, and then ignited. It was found that with ample supply of air the oil burned freely, but if the supply of air was cut off the fire went out. Fires that developed during the tests were extinguished in a few seconds by the application of a few gallons of soda-acid liquid.

These tests were so successful that the company adopted a standard procedure for extinguishing internal transformer fires. This practice is still in effect at stations having the older type transformers. A 40-gallon soda-acid chemical engine on wheels, equipped with a curved pipe suitable for inserting into any opening in the transformer is kept available for immediate use.

This method of fire extinguishment was successful in a fire involving a 10,000 kva., 70,0000/11,000 volt transformer on July 28, 1928. This fire originated from a short circuit on the internal connection board, and flames shot more than twenty feet into the air. A stream from a soda-acid extinguisher was injected into the transformer tanks by means of a curved pipe and the fire was extinguished in a few seconds.

Following the fire the transformer core was removed for inspection, repairs were made to the terminal board, loose copper particles were cleaned out, and the core was washed with fresh oil and replaced. The oil from this transformer was filtered, subjected to chemical analysis and found satisfactory for continued use. The transformer was returned to service and remained in use until it was replaced about six months later. The core remained under oil

This picture shows a typical fire involving both top and ground. The ground fire was most violent at the rear of the transformer because of a slight tilt of the transformer top.

during the entire course of the fire. Had the drain valve been opened, and the oil level dropped, this transformer would have been permanently damaged. This point is important in coping with transformer fires. The quick work of the station personnel, who had been thoroughly trained in handling the fire extinguishing equipment, was also a factor in this fire.

Oil Circuit Breaker Fires.

Oil circuit breaker fires may range from a fire in the top of a tank to a spray of burning oil thrown many feet. As a result of the tests previously referred to, a procedure was developed for fighting fires in the live pot type oil circuit breaker equipment of the Pennsylvania Water and Power Co. This procedure consists of:

11 and 13 Kv. Circuit Breakers.

1. Clear the switch affected by opening its disconnectors, and by any other switching that may be necessary. Do not clear the whole station unless all other means fail.
2. Extinguish burning oil on the floor by means of sand.
3. If the doors of the switch cells have not already been blown off, knock them off with a switch hook.
4. Extinguish the fire around the pots by means of sand. Be careful that no sand gets into the pots, as this will make the fire worse.

5. Extinguish the fire in the pots by use of a small amount of carbon tetrachloride.
6. Let the fire on the walls of the cell burn itself out.

70 Kv. Oil Circuit Breakers.

1. Clear all buses within reach of a stream of water directed into the burning switch cell. Do not clear the whole station.
2. Clear the switch affected by opening its disconnectors and by any other switching that may be necessary.
3. Throw off the door of the switch cell, if it has not already been blown off.
4. Extinguish the fire in the cell by use of soda-acid extinguisher. Start at the bottom of the frame, working up the legs, around the pots, above the pots, then in the pots, and finally along the walls and roof of the cell.

The effectiveness of the procedure outlined has been demonstrated many times and in no case have there been failures.

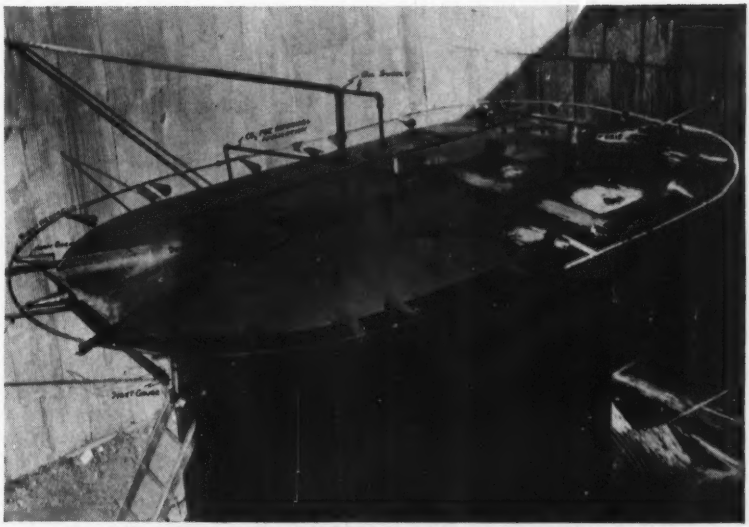
Recent tests have shown that carbon dioxide gas is also effective in such fires. When oil circuit breakers are installed in large open buildings, such as was common in older stations, it is difficult and expensive to provide a built-in, automatically controlled CO_2 system for fire protection. Where breakers are installed in compartments or rooms, such a system should be the quickest and most satisfactory method of extinguishing a fire.

At the hydroelectric plant of the Safe Harbor Water Power Corporation, the 13.8 kv. oil circuit breakers are grouped not more than five in a room. Each room is equipped with thermostats to release more than enough CO_2 to extinguish any fire occurring in that room. Releases actuated by the CO_2 pressure close all ventilating dampers. There has been no operating experience from this installation.

Training of Personnel.

The station attendant who understands the functioning and handling of fire extinguishing equipment is an important factor in effectively combating any type of fire. Too frequently attendants are unable to utilize equipment to the best advantage, a feature which was demonstrated during the early tests to such an extent that a training program was inaugurated shortly thereafter.

The training program of the Pennsylvania Water and Power Company consists of annual practice tests during which the station attendants demonstrate their ability to operate any one of a number of extinguishers on different kinds of fires. Each shift man, or any other men who are regularly around the stations, is required to don a gas mask, equip himself with an extinguisher and proceed as though fighting a station fire. The test fire which he fights is usually more severe than those actually experienced, so that the attendant gains confidence in his ability to cope with any burning station equipment. A supervisor, who is always on hand to show the operator how to improve his handling of the fire fighting equipment, records the time required to extinguish the fire and thus arouses considerable interest and competition among the men. Occasionally, during such practice tests, new extinguishers and improved methods of application are demonstrated.



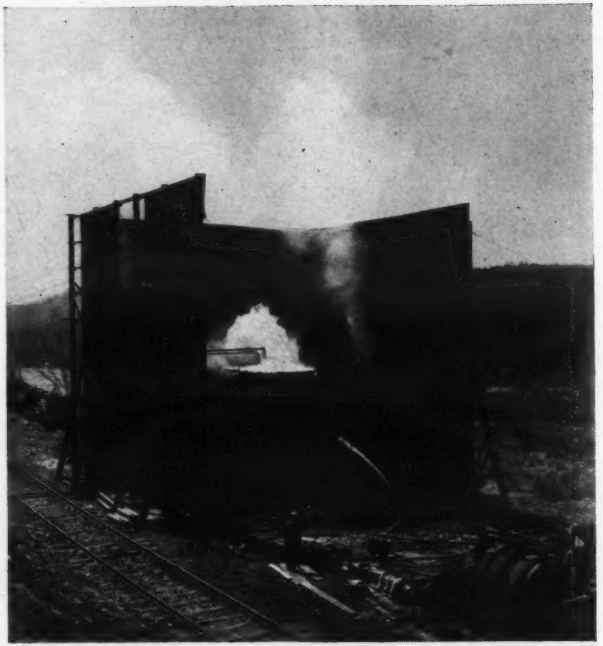
View of test transformer, showing piping arrangement at top. The large CO_2 horns shown on the diagram were not in place when this picture was taken.

Tests for the Determination of Methods for Extinguishing Outdoor Transformer Fires.

When a large investment in an entirely different type and size of outdoor transformer equipment was contemplated at the Safe Harbor plant, an extensive study was again made to determine the most effective way of extinguishing fires in this type of equipment. This installation consists of six 28,000/42,000 kva., 13.8/230 kv. oil-insulated, single-phase transformers of the conservator type with nitrogen gas cushions and two 30,000/45,000 kva., 13.8/66 kv., three-phase "inertaire" transformers, all with forced air ventilation for the higher rating. The units are installed along the upstream wall of the power house on 40-ft. centers and separated by concrete walls 40 ft. high. The floor under each unit is divided into three basins, each having a 12-in. drain.

Mounted on the walls of each transformer pocket are six nozzles which will spray water over the tops and sides of the units when the header to which they are joined is connected to the station-service water supply by a flexible hose equipped with a quick-connecting coupling. The hose connection is made on the opposite side of the fire-wall from the transformers so station attendants do not have to approach a burning transformer. With an extra hose connection they are free to extinguish any ground fire that may occur under the transformers. Of course the transformers would be de-energized before the water is turned on.

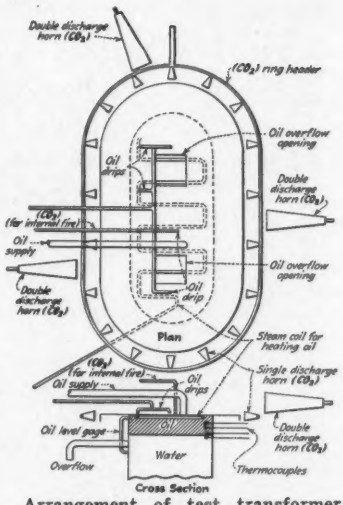
View of violent ground fire and light top fire, taken just before application of chemical mixture on Test No. 15. The intensity of the fire is controlled by the amount of oil spilled and by the degree to which it is spread on the ground.



View of Test No. 14 approximately 15 seconds after discharge of six 50-lb. cylinders of carbon dioxide. Note gas banking on top of transformer and the control of ground fire by use of a hose stream.

The only fires that are considered probable with these units are those which would involve the bushings or conservator tank or would be caused by a ruptured transformer tank or top.

In the tests made to simulate such fires an old 10,000 kva. transformer tank provided with a false top of the same dimensions as the 230 kva. units was supported on cinder-covered cribbing in a three-sided pocket of the same dimensions and height as at Safe Harbor. The tank was filled with water on which was floated a 12-in. layer of transil oil. After heating this oil with a steam coil to 120-160° C. it was ignited with a flaming oil rag carried on a messenger wire. The oil was allowed to burn from six to twenty minutes and then forced to spill out of openings in the tank cover by forcing water into the bottom of the tank. By spilling an average of 150 gallons of oil per test a severe fire was obtained on the top, ground and throughout the pocket, as indicated by the accompanying illustrations.



Arrangement of test transformer for fighting fires.

Four ¼-in. oil drips located over the tank cover were allowed to add to the fire during some of these tests.

Extinguishers and Methods of Application.

Selection of extinguishers for test purposes was influenced by such factors as cleanliness, electrical conductivity, supply, first cost, maintenance, etc. Three extinguishers were tested—carbon dioxide, water, and a chemical mixture of aluminum sulphate, bicarbonate of soda and water.

Foam was considered among other different extinguishers, but it was eliminated from the test program on account of the residue following its application.

Carbon Dioxide.

Two methods of fighting fire with carbon dioxide gas were tried.

1. A ring-header system feeding eighteen 3/32-inch nozzles equipped with discharge horns supported around the edge of the transformer top.

2. Three double-discharge horns on the same level as the transformer top and discharging across it.

Liquid CO_2 was supplied to these nozzles at approximately 700 to 800 lb. pressure. It was agreed that the CO_2 gas applied in this way would fight only the top fires, while a fire hose was used on the ground fires.

View of water discharge from lower set of J-tubes. Fire was extinguished in 4½ minutes. This is the same fire illustrated on page 43.

View of discharge of chemical mixture from J-tubes. Note how erratic the discharge appears. Top fire extinguished in three minutes.

This picture shows CO_2 gas issuing from openings after the discharge of two 50-lb. cylinders directly into the transformer top. The internal fire was extinguished in less than one minute. Note J-tubes in position on left wall of test enclosure.

Water.

The failure of water in numerous instances to effectively control large oil fires has created an adverse feeling toward its use on transformer fires. This feeling is somewhat biased, for water possesses certain desirable qualities which are often rendered of little value because of methods used in applying it as an extinguisher.

In conducting tests for water extinguishment of transformer fires a total of twelve nozzles (called J-tubes because of hooked appearance) were arranged in two tiers on the two side walls of the transformer pocket. Only the lower tier of nozzles was used in the first tests, while both tiers were used in later tests, the upper set being used to spray the top, and the lower tier the sides.

Chemical Mixture.

The same nozzles used to spray the water were used for the chemical mixture, which was mixed in a generator originally designed for the application of foam. This device combined aluminum sulphate, bicarbonate of soda and water in the proportions of 50 pounds of sulphate to 45 pounds of soda.

TRANSFORMER FIRE PROTECTION TESTS

TEST NO.	DATE 1932	TEMP. °C. OIL	FLAME	NATURE OF FIRE	INTENSITY	EXTINGUISHER	& MIN. OF DISCH.	PIPING ARR'G'MT	AMOUNT USED	TIME TO TOP	QUENCH GR'D.	RESULTS
1	4-1	140	-	Spill over	Top: Vigor. Grd: Small	Water	8	6 lower J-Tubes	-	-	-	failure
2	4-13	153	640	Spill over & drip oil	Top: Severe Grd: "	"	11	"	-	-	4 Min.	success
3	4-14	159	658	Spill over	Top: Severe Grd: "	"	5	"	875 gal.	4 min.	5 min.	success
4	4-14	158	635	Spill over & Drip oil	Top: " Grd: "	Chem. Mix.	5	"	-	4 min.	4 min.	success
5	4-19	159	655	"	See Picture 3	(CO_2) Gas	1	ring header	300#	-	3 min.	failure
6	4-19	Oil burn. from #5		Spill over	See Picture 4	Water	3	6 lower J-Tubes	525 gal.	1.75 min.	2.75 min.	success
7	4-19	152	580	Spill over & Drip oil	Top: Light Grd: Severe	(CO_2) Gas	1.5	3 horn system	300#	-	-	failure
8	4-19	Oil burn. from #7		"	Top: Severe Grd: Severe	Water	4	6 lower J-Tubes	700 gal.	3.25 min.	4 min.	success
9	4-20	153	642	"	Top: Severe Grd: Light	(CO_2) Gas	1.3	ring header	300#	1 min reflash	-	failure
10	4-20	Oil burn. from #9		"	Top: Severe Grd: Severe	Water	6	6 lower J-Tubes	1050 ga.	3 min.	5 min.	success
11	4-20	153	660	Spill over	Top: Severe Grd: Light	(CO_2) Gas	.75	ring header	300#	1 min.	2 min.	success
12	4-27	139	595	Spill over & Drip oil	Top: Light Grd: Light	Water	4	12 J-Tubes	1750 ga.	3 min.	2 min.	success
13	4-27	148	630	"	"	Chem. Mix.	3.5	12 J-Tubes	-	3 min.	3 min.	success
14	4-28	142	640	Spill over	Top: Severe Grd: Severe	(CO_2) Gas	.75	ring header	300#	-	2 min.	failure
15	4-28	Oil burn. from #14		"	"	Chem. Mix.	4.5	12 J-Tubes	-	3 min.	4 min.	success
16	4-28	140	608	Spill over & Drip oil	"	Water	2.5	12 J-Tubes	750 gal.	1 min.	1.5 min.	success
17	4-28	120	254	Internal	Light	(CO_2) Gas	-	1 inch pipe	100#	1 min.	-	success
18	4-28	156	695	Spill over & Drip oil	See Picture 3	(CO_2) Gas	1.3	ring header	600#	1 min.	2.5 min.	success
19	4-28	151	410	"	"	Chem. Mix.	3	6 Upper J-Tubes	-	2 min.	7 min.	success

Results of Tests.

The results of the tests are shown by the accompanying tabulation. In the tests with CO_2 gas it was successful in extinguishing four top fires out of six involving both top and ground. (With the facilities installed it was agreed that the CO_2 would not be used to fight the ground fires.) One test was made to determine the effectiveness of CO_2 on an internal fire, and in this instance extinguishment was effected in one minute and the temperature inside the top lowered to 11° C. two minutes after the discharge began.

With water, only the first test was a failure, and that was due to poorly shaped and located nozzles. They were changed so each discharge was in the form of a spray and joined that of the adjacent nozzle before reaching the transformer. Some of the test fires in which water was successfully used were the most violent of the entire program. The minimum time to quench a top fire was one minute, and the maximum 4½ minutes. In every test the water spray was sufficient to quench the ground fire without the use of an auxiliary extinguisher. The time to quench fires was lowered by using both upper and lower tiers of nozzles, which collectively discharged 300 gallons per minute at 27 lbs. pressure, compared with 175 gallons per minute for the lower tier alone.

Results of the four tests with the chemical mixture were particularly satisfactory, as three of the fires quenched were unusually severe. The reaction of the chemicals caused an uneven spurting discharge at the nozzles. A thin film of white chemical covered the transformers and walls of the pocket after the discharge of the extinguisher, but it was easily removed by means of a water spray from a hose.

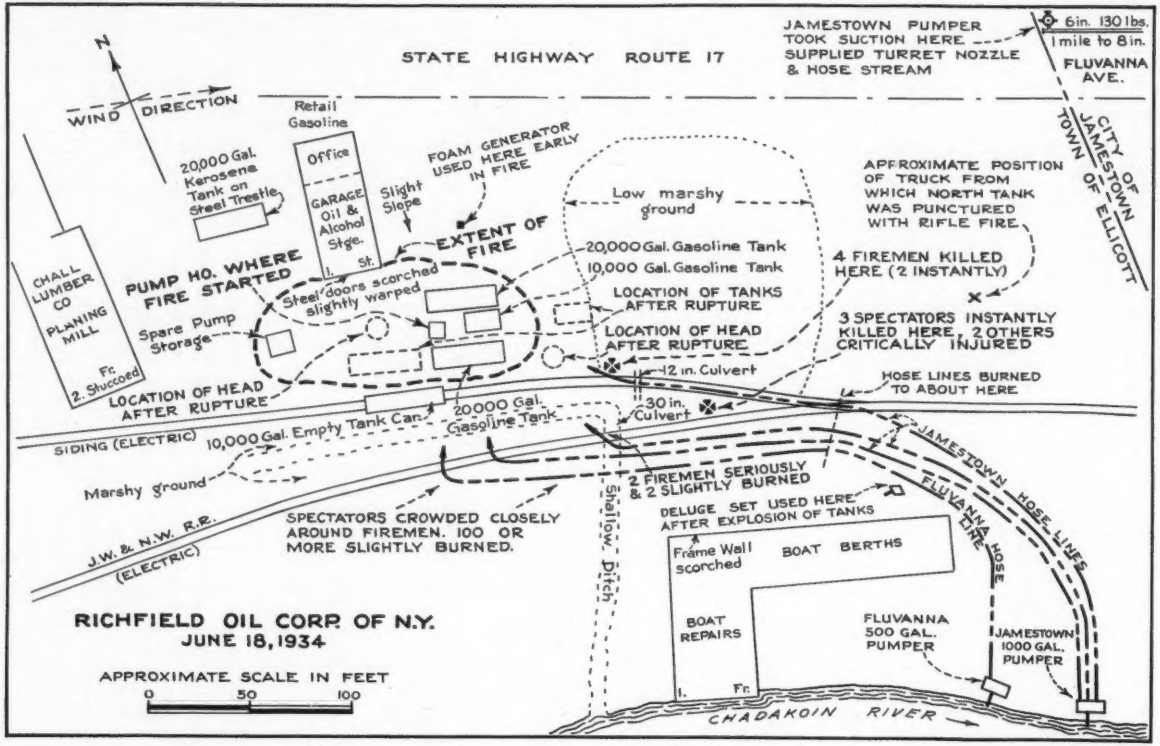
Conclusions.

CO_2 gas was found suitable for extinguishing internal fires in transformers, but not reliable in controlling violent external fires. Ground fires required auxiliary extinguishing means.

The chemical mixture proved very effective in controlling severe top and ground fires without the use of an auxiliary extinguisher. It acts almost as quickly and is as reliable as water.

Water possesses the most desirable features for protection against outdoor transformer fires. It is relatively quick, its supply is unlimited, it is clean, requires small maintenance and can be supplied in flexible arrangements. The cost of installing the protection is very low.

The water and spray connections as installed at Safe Harbor can be readily made by one man unaided, and then he is free to fight ground fires with the auxiliary hose, or to flood any portion of the cell not covered by spray. The installation of this equipment does not jeopardize any of the electrical connections to the transformer during their normal service. In the event that the fire is of an external type, the internal parts of the transformer are not affected.


N
WIND DIRECTION
STATE HIGHWAY ROUTE 17
JAMESTOWN PUMPER TOOK SUCTION HERE SUPPLIED TURRET NOZZLE & HOSE STREAM
6 in. 130 lbs.
1 mile to 8 in.
FLUVANNA AVE.
CITY OF JAMESTOWN
TOWN OF ELLICOTT
Retail Gasoline
Office
GARAGE Oil & Alcohol Stge.
20,000 Gal. Kerosene Tank on Steel Trestle
FOAM GENERATOR USED HERE EARLY IN FIRE
Slight Slope
EXTENT OF FIRE
PUMP HO. WHERE FIRE STARTED
Steel doors scorched slightly warped
Spare Pump Storage
CHALL LUMBER CO PLANING MILL
Fr. 2. Stuccoed
LOCATION OF HEAD AFTER RUPTURE
Low marshy ground
20,000 Gal. Gasoline Tank
10,000 Gal. Gasoline Tank
LOCATION OF TANKS AFTER RUPTURE
LOCATION OF HEAD AFTER RUPTURE
APPROXIMATE POSITION OF TRUCK FROM WHICH NORTH TANK WAS PUNCTURED WITH RIFLE FIRE
4 FIREMEN KILLED HERE (2 INSTANTLY)
3 SPECTATORS INSTANTLY KILLED HERE, 2 OTHERS CRITICALLY INJURED
12 in. Culvert
30 in. Culvert
HOSE LINES BURNED TO ABOUT HERE
SIDING (ELECTRIC)
10,000 Gal. Empty Tank Car
20,000 Gal. Gasoline Tank
Marshy ground
J.W. & N.W. R.R. (ELECTRIC)
SPECTATORS CROWDED CLOSELY AROUND FIREMEN. 100 OR MORE SLIGHTLY BURNED.
2 FIREMEN SERIOUSLY & 2 SLIGHTLY BURNED
DELUGE SET USED HERE AFTER EXPLOSION OF TANKS
Shallow Ditch
JAMESTOWN HOSE LINES
FLUVANNA LINE HOSE
Frame Wall scorched
BOAT BERTHS
BOAT REPAIRS
FLUVANNA 500 GAL. PUMPER
JAMESTOWN 1000 GAL. PUMPER
Fr.
CHADAKOIN RIVER
RICHFIELD OIL CORP. OF N.Y.
JUNE 18, 1934
APPROXIMATE SCALE IN FEET
0 50 100

Jamestown Gasoline Storage Fire.

Report by R. W. Gieseler (Member N.F.P.A.),
Eastern Underwriters Inspection Bureau.

Four firemen and three spectators were burned to death, several were critically burned, and a hundred or more suffered minor burns when two gasoline tanks exploded during a fire in the bulk oil distributing plant of the Richfield Oil Corp.,[1] just outside the city limits of Jamestown, N. Y., on June 18, 1934. Fire started in a pump house from ordinary electrical equipment, not suitable for use in the presence of flammable vapors. The casualties occurred when two horizontal tanks, inadequately vented, suddenly ruptured from internal pressure generated by the heat of burning gasoline on the ground.

The accompanying plan shows the construction and arrangement of the plant, which was in appearance typical of the smaller bulk distributing stations throughout the United States and Canada, with a location superior to the average in respect to surrounding property. A retail gasoline station at the north side of the property, a garage and lubricating oil, alcohol and kerosene storage were not involved in the fire. Combustible buildings on adjoining property approximately 100 ft. from the main body of the fire were exposed but not ignited.

The Gasoline Tanks.

The three gasoline tanks (north to south on plan) were respectively of 20,000, 10,000 and 20,000 gallons capacity. The two 20,000-gallon tanks were about 10 ft. in diameter and 35 ft. long; the 10,000-gallon tank 10 ft. in diameter and 17 ft. long. All three were of the horizontal type, supported on concrete cradles about one foot above the ground, with piping connections through the top for unloading from tank cars and through the bottom for pumping connections for discharge into tank trucks. All three tanks were constructed of steel of adequate thickness. The tank at the north was of riveted construction; the other two tanks, which ruptured, were of welded construction, bearing Underwriters' Laboratories label for underground installation. All three tanks had tightly bolted manhole covers, and a gauge hatch of a type which affords a two-inch diameter vent to relieve internal pressure. No other emergency venting facilities were noted in an examination

NOTE: Several points where the statements of the Richfield Oil Corp. differ in detail from the author's report are given in footnotes. The comments of the company were not received in time to verify these details with the author. It will be noted that for the most part they deal with features which are not of great significance.—Ed.

[1] Leased from the Superior Oil Works of Warren, Pa.

Acme.

The burning of the Richfield Oil Co. gasoline distributing plant near Jamestown, N. Y., on June 18, 1934. Seven men were burned to death and many injured when two gasoline tanks (wreckage in foreground) exploded, due to inadequate vents. This picture shows the 20,000-gallon tank in the middle background burning at the manhole and at the end punctured by rifle bullets in an attempt to relieve the pressure. At the right is the shell of the 10,000-gallon tank blown 45 ft. from its original position. The stuccoed frame walls of the building at the left were uncomfortably hot to touch inside the building, but no fire ensued. This picture was taken in the early evening, some time after the period of maximum severity.

of the tanks after the fire. According to the N.F.P.A. Flammable Liquids Ordinance even a 2½-in. diameter vent for tanks of this capacity would permit generating an internal pressure of about twenty-five pounds per sq. in. under assumed fire conditions. One lb. per sq. in. is stated as a conservative pressure to allow for ordinary horizontal tanks; a vent about 5½-in. in diameter is required to limit the pressure to 1 lb. per sq. in. in a tank of from 10,000 to 20,000 gallons capacity.

An examination of the tanks after the fire indicates that the welding at joints performed in a satisfactory manner, and rupture to have been due to internal pressure due to inadequate venting. The provision of approved vents would unquestionably have prevented the rupture and in turn prevented loss of life. The riveted tank, of markedly heavier construction than the welded tanks, performed more satisfactorily as to rupturing resistance. The first ring at the west end is noticeably bulged, as is the west head, and although the metal at the edge of the first ring apparently was almost at melting point, and the metal is slightly sheared, the tank did not rupture, and finally vented itself by blowing off the manhole and directing the burning gasoline upward rather than on the fire fighters and onlookers.

No dikes were provided around the tanks; owing to the natural drainage away from exposed property, dikes would not have been considered necessary.

The Pump House.

Between the two 20,000-gallon tanks there was a small iron-clad pump house about 7 ft. square, the west half being 1 story in height and housing the various control valves, exposed pipe lines, and switch for gasoline pump. In addition, from the evidence of the refuse at the site, this area contained a number of wrenches, about two dozen empty oil cans of quart size, an ordinary milk can, and other refuse. To the east was the pump used for handling gasoline, in a half story lean-to, separated from the control room by corrugated iron on wood studding. This was an ordinary rotary pump usual for purpose, driven through spur gears by an ordinary open motor, with open brushes and commutator.[2]

The lighting in the control room was by an ordinary exposed electric light, with an ordinary type toggle switch, and wiring part in rigid conduit and part in flexible conduit. The motor control switch observed after the fire is of the ordinary knife type with fuses in a metal box (not vaporproof) with outside lever.[3] Below this in the line to the motor was an ordinary household type toggle switch.

Tank cars were unloaded here by gravity to this pump, which delivered gasoline to the storage tanks. Tank trucks were loaded by pumping from the

[2] The Richfield Oil Corp. states that the brushes and commutator were enclosed by a housing of light iron, and that the pump and motor were separated by a metal partition.

[3] The Richfield Oil Corp. states that this was a vaporproof switch and that there were no fuses.

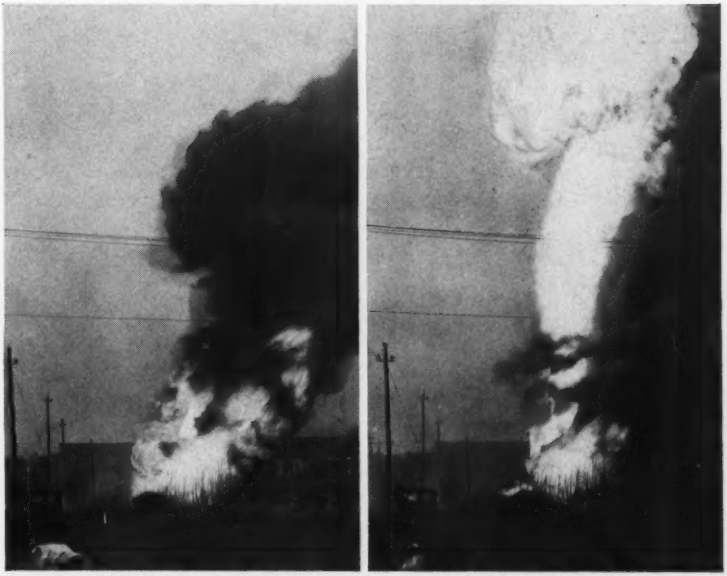
The gasoline pump with open commutator type motor and ordinary type electric switch in the foreground of this picture were responsible for the start of the fire. At the right is the chemical extinguisher which the truck driver brought but did not use because the fire was already too severe. In the background is the wreckage of the 10,000-gallon tank, ruptured from internal pressure and blown 45 ft. from its concrete cradle.*

tanks, using the same pump. All valves were ordinary gate valves. All piping was above ground. The fill and emptying lines of two tanks entered at the top, and on the other tank the fill and emptying lines entered at the bottom. Each tank had a drain valve at the bottom; it could not be determined after the fire whether these were connected by piping to the pump house.

The Story of the Fire.

According to testimony at the coroner's inquest, on the morning of June 18th a tank car containing 10,000 gallons of gasoline was unloaded, requiring

*See footnotes 2, 3 and 4.



Left: At 4:50 P.M. an attempt was made to relieve the pressure in the north 20,000-gallon tank by puncturing the head with a high powered police rifle fired from the truck at the left of this picture. Right: Two minutes later the manhole blew off.

four hours' pumping, which ended at about 1:30 P.M. At this time the total storage in the three tanks was about 28,000 gallons; the exact distribution in the three tanks cannot be learned.

At about 2:45 P.M. a tank truck driver began filling his truck. Filling required the opening of valves to feed from the proper storage tank to a meter mounted outside the pump house, with a vertical pipe to a point about 12 ft. above the ground, terminating in a return elbow and with a hose connection to the truck tank. After 105 gallons of gasoline had been pumped into one compartment of the truck, the driver went into the pump house and changed the valves to fill another compartment with ethyl gasoline. He then reached through the window to throw the switch to start pumping and was knocked down by a mild explosion.[4]

He ran to the main building, took a chemical extinguisher back to the fire, but saw that its use would be futile.[5] He then ran back to the main building, yelled "Fire," and returned to drive his truck away from the fire.

At the call of fire, both the Jamestown and Fluvanna fire departments were summoned. These calls were received at 3:12 P.M. The first company

[4] The driver is reported as stating that he saw no flame and heard no explosion, but that something seemed to hit him in the stomach.

[5] The Richfield Oil Corp. states that the extinguisher was in the pump house, but the driver could not reach it, as the fire was already too severe.

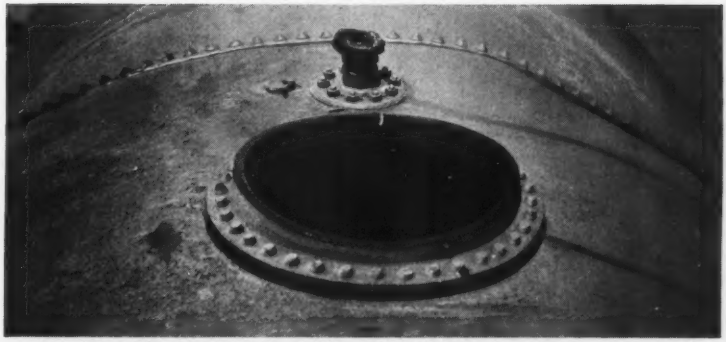
Looking south from near the garage and office building, showing north 20,000-gallon tank, bulged from heat but not ruptured, with broken suction pipe at the top. Beyond is the shell of the south 20,000-gallon tank, blown 40 ft. from its original position.

to arrive at the scene was Jamestown Company No. 1, equipped with chemical tank and hose. This company was immediately followed by the ladder truck, carrying a foam generator and six cans of foam powder. These companies connected to the hydrant at the Jamestown city line, 340 ft. from the main building of the bulk station. Two lines were connected, the first being connected to the foam generator at a position about 30 ft. to north of the north tank and at east side of main building. The other was taken into the yard and played on to the pump house from the west. A ladder was placed against the side of the north tank and firemen directed a foam stream over this tank on to the pump house. After using four cans of foam, the captain of this company, noting that there was a steady stream of burning gasoline spreading under the tanks, withdrew both streams to a position nearer the street and played water on the nearest tank and on the main building.

Meanwhile a 1000-gallon pumper from Jamestown and a 500-gallon pumper from Fluvanna arrived and took suction from the river (see plan).

Three lines were laid from the Jamestown pumper and one line from the Fluvanna pumper. One Jamestown line was run along the railroad siding to a position about 50 ft. from end of south tank, two others were run along the main track, and the line from the Fluvanna pumper was laid along the track to a position where it could be played over the tank car on the siding near the tanks. These streams were all manned by four men each. The efforts of the firemen were directed to the cooling of the tanks to prevent explosion.

It is apparent that the original puff broke a connection in the pump house, which permitted the syphoning of the contents of one or more of the tanks, which provided the fuel for the fire. As the heat increased, the pressure in the tanks increased, providing added fuel due to the lack of adequate vents.



Manhole and gauge hatch of the north 20,000-gallon tank. Note crack in manhole frame which permitted cover to blow off.

Meanwhile the fire had attracted immense crowds of people until the roads were blocked for about a mile in each direction, and the sightseers pressed closer and closer until the main track of the railroad was jammed with people. The Jamestown police attempted to assist the fire department in clearing the onlookers from the danger zone. Several deputy sheriffs also attempted to assist this work, but without success. Just as Chief Beatty of Jamestown was about to give orders to turn one of the hose streams on the crowd to get them out of danger, at 3:45 P.M. the 10,000-gallon gasoline tank exploded from internal pressure, the west head being thrown 40 ft. and the shell and east head intact thrown off its cradle to a point at edge of the marshy ground 45 ft. distant. Fifteen seconds later the 20,000-gallon tank at the south similarly ruptured by blowing out the east head to a position 20 ft. distant, driving the shell and west head 40 ft. west of its original position and plowing up the ground to a depth of about a foot. At the first explosion the firemen, manning the two east lines of Jamestown hose, started to abandon their lines, and the onlookers on the main track to south attempted to run, but the second rupture followed the first so quickly that they were enveloped in a wave of blazing gasoline. All four firemen manning the easterly line were killed, the first two men on the line being burned beyond recognition, the other two so badly that they died of their burns later in the evening. Two other firemen were still on the danger list on July 3. Three of the onlookers died within a few hours. Two other onlookers are in hospitals not expected to live. Those taken to hospitals totaled twenty-nine, including the chief of the Jamestown fire department, and hundreds were treated at the scene. It is said that the clothing of all those along the track was ignited, and superficial burns were numerous, though the most seriously burned were the four firemen at the second line from Jamestown pumper and several onlookers standing close to them.

The utmost confusion naturally resulted from this catastrophe, and all local ambulances, doctors and nurses were summoned. Traffic congestion

delayed the response considerably, although the entire police force, including the off duty members, were already on duty attempting to clear the congestion.

The fire continued to burn fiercely. The fire department forces were reorganized, and the onlookers no longer hampered their efforts. Two lines from the Jamestown pumper were siamesed to a deluge set, which was set up on the main railroad track, and the turret nozzle of the ladder truck was used to attack the fire from the rear. The second Jamestown pumper was brought into action, taking suction from the only available hydrant to supply this turret nozzle. Another hose line was laid and later used inside the main building of the bulk station to prevent ignition.

The north tank was burning at a broken pipe at the west end of the tank. This was a suction pipe, running to the bottom of the tank and was spraying gasoline, due to the internal pressure. This tank was also burning at the gauge hatch. Fearing another explosion, the police department was called upon to relieve the pressure. High powered rifles were used at 4:50 P.M. to puncture the tank; after the fire 33 bullet holes were counted in the east head. These were slightly effective in relieving the pressure, but due to their small size, slightly larger than ¼ in., were inadequate, and two minutes later the entire manhole blew off, sending a column of flames high into the sky. The cast iron manhole ring split, leaving a gap ⅜ in. wide, permitting the manhole cover to blow off and relieve the pressure.

After this the extinguishment was simplified, and continuing to use turret nozzles and two streams manned by firemen, the fire was finally extinguished at 10:30 P.M.

The actual property damage was small, as the main building of the bulk station was hardly damaged, and the neighboring properties were not damaged.

Chicago Stock Yards Conflagration.

Report by Chicago Board of Underwriters,

(Member N.F.P.A.).

On May 19, 1934, the city of Chicago was the scene of a conflagration which, for a time, threatened to assume the proportions of the memorable conflagration of 1871. The fire started in the yards section of the Union Stock Yard and Transit Company's property shortly after 4 P.M., quickly reached conflagration proportions, and was not brought under control until about 10 P.M. The efforts of the major portion of the fire fighting facilities of the fire department were engaged at the fire, which destroyed about 80 per cent of the pens and runways of the yards, as well as a very considerable number of buildings, including one large building of fire-resistive construction. About 800 head of cattle were burned to death, one employee lost his life, and property damage estimated at $6,000,000 resulted from the fire.

Description of Area Involved.

The stock yards and packing house district is located in practically the geographical center of the city in an area approximately one mile square. It is divided into two sections by Racine Avenue (see map), the western half being compactly built with meat packing plants and accessory buildings, and the eastern half (involved in the fire) occupied mainly by stock pens, sheds and barns, with hotel, bank, and allied mercantile and exhibition buildings on the eastern edge. East of South Halsted Street is a fringe of minor mercantile occupancies, with a largely frame residential district, interspersed, particularly to the northeast, with various manufacturing plants.

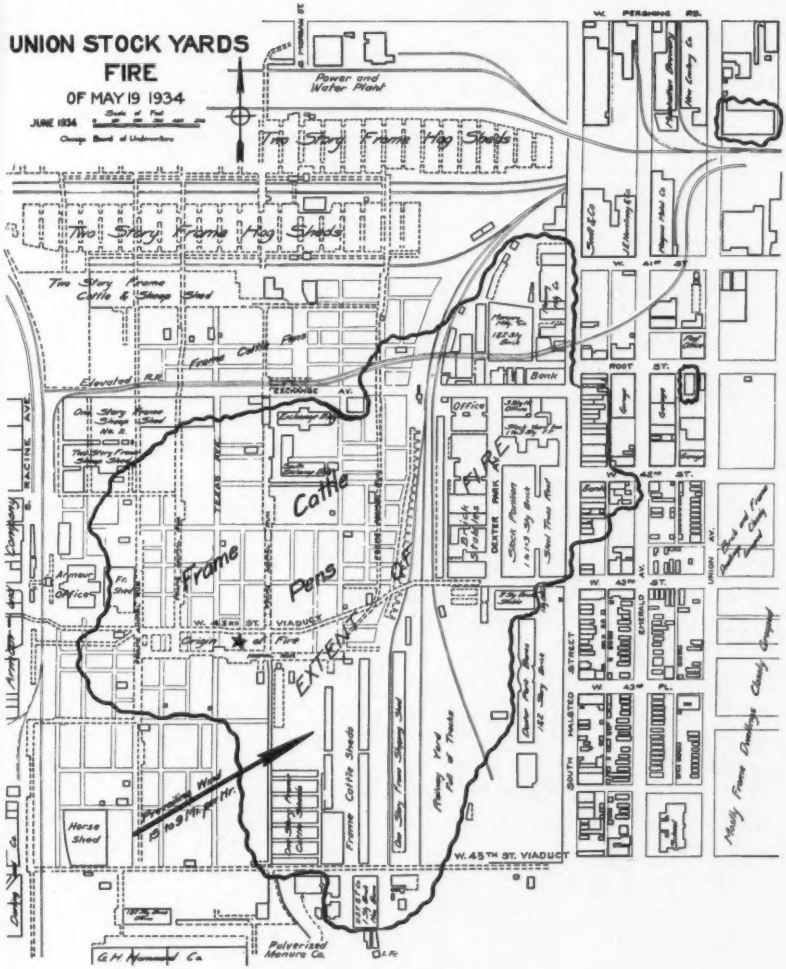
Weather Conditions.

Official records of the United States Weather Bureau describe the day of Saturday, May 19, as "unseasonably warm and uncomfortable." Temperatures during the period of the fire from 92° F. at 4:00 P.M. to 88° F. at 9:00 P.M. Humidity was approximately 25 per cent during the same period and had been unusually low for the temperatures recorded during the week previous to the fire. Rainfall had been exceedingly light, none of consequence having fallen since April 11. The total rainfall since January 1 was but 34 per cent of normal.

This report has been extracted from a complete detailed report of this fire prepared by the Chicago Board of Underwriters in collaboration with the National Board of Fire Underwriters. Copies of this complete report may be obtained from the Chicago Board of Underwriters, 175 West Jackson Blvd., Chicago, Ill.

Property Involved, Stock Yards Conflagration, Chicago, May 19, 1934.

Description	Area	Construction	Occupancy	Building Damage	Contents Damaged
Pens and livestock	50 acres	Wooden planks	Cattle pens	Total loss	800 head of cattle burned
Runways	7,700 feet	Plank and timber	Runways	Total loss	.....
Viaducts	3,000 feet	Plank and timber	Public thoroughfares	Total loss	.....
Frame buildings—Yard area	277,000 sq. ft.	Wood frame	Cattle sheds, barns, etc.	Total loss	Total loss
Buildings west of Dexter Park Av.	112,000 sq. ft.	2-story brick joisted	Stables, offices, etc.	Total loss	Total loss
Stock pavilion—South Halsted St.	148,900 sq. ft.	1 3-story part brick, part fire-resistive	Sale arena	70 to 90 per cent	Total loss
Stock Yard Inn and Breeders Building	59,100 sq. ft.	1- to 4-story part brick, part fire-resistive	Hotel, club offices and stores	Total loss to brick section, 50 to 75 per cent to fire-resistive	Total loss
Live Stock National Bank	.....	2-story fire-resistive	Bank	40 to 50 per cent	Considerable
4132-4142 South Halsted St. (West) and Exchange Ave.	40,200 sq. ft.	1 and 2-story brick joisted	Misc. manufacturing and garage	About 90 per cent	Total loss
4122-24 South Halsted St. (West)	.....	1 and 2-story brick joisted	Meat packing	Total loss	Total loss
4100-4124 South Halsted St. (West)	42,600 sq. ft.	3-story brick semi-mill and joisted	Manufacturing	Total loss	Total loss except contents of fire-resistive vault
4044-46 South Halsted St. (West)	6,200 sq. ft.	2-story fire-resistive	Wholesale market	50 per cent	Total loss
813-15 Exchange Ave.	3,300 sq. ft.	2-story fire-resistive	Printing plant	Gutted but in fair shape	Nearly total
820-22 Exchange Ave.	3,000 sq. ft.	2-story brick joisted	Misc. mercantiles	Total loss	Total loss
826 Exchange Ave.	1,950 sq. ft.	2-story brick joisted	Fire Station	Total loss	Total loss
834-36 Exchange Ave.	20,760 sq. ft.	1-story brick semi-mill and 4-story brick joisted	Drovers Journal Publishing Co.	Total loss	Total loss
834-36 Exchange Ave. (rear)	.....	2-story brick joisted	Misc. storage	Total loss	Total loss
834-36 Exchange Ave. (and rear)	7,000 sq. ft.	2-story brick semi-mill	Woodworking shop	Total loss	Total loss
840-42 Exchange Ave. and rear	8,700 sq. ft.	1-story brick joisted and frame	Misc. manufacturing and mercantile	Total loss	Total loss
Dexter Park Ave. and 43d St.	17,000 sq. ft.	2-story brick joisted	Live stock show	Total loss	Total loss
Exchange Building, Exchange Ave.	16,700 sq. ft.	8- and 9-story fire-resistive	Office building	70 per cent	Total loss
South Exchange Building	18,400 sq. ft.	3-story brick joisted	Office building	Total loss	Total loss
South Exchange Building annex	1,750 sq. ft.	3-story fire-resistive	Office building	Gutted, but salvage value	Total loss
45th St. Warehouse	28,400 sq. ft.	1-story brick joisted	Storage	Nearly total loss	Total loss
Pulverized Manure Co.	6,700 sq. ft.	1-story brick and frame	Manufacturing	Total loss	Total loss
Mill and Dryer House	4,700 sq. ft.	3-story brick and frame		Severely damaged	Severely damaged
Miscellaneous Buildings in Yard	.....	Brick and fire-resistive	Scale houses, offices, etc.	Some badly damaged, others totally destroyed	
4157-93 South Halsted St. (East)	40,000 sq. ft.	2- and 3-story brick joisted	Misc. mercantiles	Some badly damaged, others totally destroyed	
Drovers National Bank	9,100 sq. ft.	1- and 4-story brick joisted	Bank	Total loss	Total loss except contents of fire-resistive vault
4211-23 South Halsted St. (East)	12,000 sq. ft.	1 to 3-story brick and frame	Misc. mercantiles	Total loss	Total loss
4200-10 South Emerald Ave.	.....	1 to 2-story frame	Dwellings and stables	Total loss	Total loss
707-9 Root St.	4,000 sq. ft.	1-story frame	.....	Badly damaged	.....
3939-53 South Union Ave.	25,000 sq. ft.	1-story brick and frame	Vacant	Badly damaged	.....
Miscellaneous Property	.....	700 feet of elevated railway structure and one car 100 stock and refrigerator railroad cars Several automobiles Public utility equipment		.....	.....



Story of the Fire.

The fire started shortly before 4:21 P.M. in the cattle pens of the Union Stock Yard and Transit Company's property in the vicinity of 43rd and Morgan Streets. The fire was discovered by company watchmen, who immediately sent in an alarm from a central station system fire alarm box located in a watchman's shanty near by. The fire, in all probability, was caused by a cigarette discarded from an automobile passing over the 43rd St. viaduct.

This ignited loose hay in the pens and, fanned by a moderate southwest wind, the flames spread rapidly in all directions, but principally northeast. Ready fuel was furnished by the wooden framework of the pens, the elevated frame cattle runways with hay storage sheds above and by the frame viaducts, all in a highly combustible condition due to the prevailing drought conditions.

The first fire companies to arrive found a considerable area of pens involved, and the fire, even at this stage, was leaping over gaps of 50 to 100 feet, starting new fires. These companies, Engines 53 and 59, connected to a hydrant on the private water mains in front of the fire on Texas Ave., which is nothing more than a narrow lane between sections of pens. The firemen operated two streams for less than five minutes, when they found themselves surrounded by fire and were forced to abandon hose and apparatus. It was stated by an eyewitness that the fire traveled along the pens nearly as fast as a man could run. One employee of the stock yards lost his life near this location while driving cattle from the pens.

Five minutes after the first alarm, a 4-11 alarm was transmitted from the nearest city fire alarm box. This box was destroyed by the fire shortly after, so that it was necessary to send a fireman to the quarters of Engine 59, nearly half a mile away, from which the 5-11 alarm was transmitted nine minutes later.

By 4:45 P.M. the fire in the cattle pens, runways, and sheds was out of control. This condition was aggravated by the scarcity of hydrants and the inaccessibility of the fire, due to lack of through streets in the area. It is difficult to describe exactly the progress of the fire on all fronts, but at this time it was beginning to involve the following major buildings or groups of buildings: the 3-story brick South Exchange Building to the north; the 2-story brick horse barns to the east, along the west side of Dexter Park Ave.; and the large 1-story hay barn and the brick and frame buildings of the Pulverized Manure Company to the south. The moderate southwest wind seemed to increase to gale proportions, which experience has shown to be common in extensive fires of this sort.

The fire was spreading rapidly to the northeast and a definite stand was made on Exchange Ave., west of the railroad, at 4:35 P.M., but this position soon became untenable. The South Exchange Building, of 3-story brick joisted construction, was destroyed and the fire communicated to the 8-story Exchange Building. Although this building was gutted, the fact that it was of fire-resistive construction, together with the fair clear space to the north, was of much value in preventing further spread to the north at this point. Just east of the Exchange Building, peculiar draft conditions and effective hose streams left a 3-story brick office building practically untouched.

A remarkable stop, deserving of special mention, was made by the fire department in a sheep shed at the southwest corner of Exchange and Texas

International.

Unfavorable weather conditions combined with excessive quantities of combustible wood construction in the form of pens, runways, viaducts and frame buildings to make possible the rapid spread of the fire through the entire area.

Avenues. The east portion of this building had become seriously involved, and had it not been for the vigorous attack by the fire department the fire would very likely have spread northward into the most congested portion of the yards section, consisting of two rows of frame double-decked hog houses extending continuously for nearly a half mile across the north end.

To the south the fire was stopped just south of the West 45th St. viaduct; several buildings were destroyed, including a large hay barn and a small fire division of the Pulverized Manure Company building, the communication to the larger fire division being effectively protected by double automatic fire doors.

At about 4:45 P.M. a second stand was made by the fire department in the path of the fire to the northeast along Dexter Park and Exchange Avenues, but the oncoming wave of heat and flame was of sufficient intensity to practically instantaneously involve entire buildings in its path. Large quantities of water from heavy streams seemed to have no material retarding effect on the fire. Freak currents of heated gases and sparks swept over intervening buildings and attacked the frame porches on the rear of buildings on the east side of South Halsted St., about 660 feet distant, at about 5:00 P.M. Shortly after, this heat wave attacked the buildings on the east side of Dexter Park Ave., which became involved with great rapidity, as shown by the destruction of Engines 43 and 98, located at hydrants on Dexter Park Ave. The buildings north of Exchange Ave. and west of South Halsted St. quickly ignited and Engines 8 and 14, located at a hydrant on Exchange Ave., just west of the quarters of Engine 59, were destroyed.

At this time, the fire was at its greatest intensity and it was impossible to predict where it would end. The fire marshal then ordered a third stand, which proved to be successful, on South Halsted St., from 40th to 43rd Sts., reinforced as far east as Union Ave. by the companies arriving in response to the numerous special calls. The extent of the fire to the east was confined practically within the limits protected by this final stand.

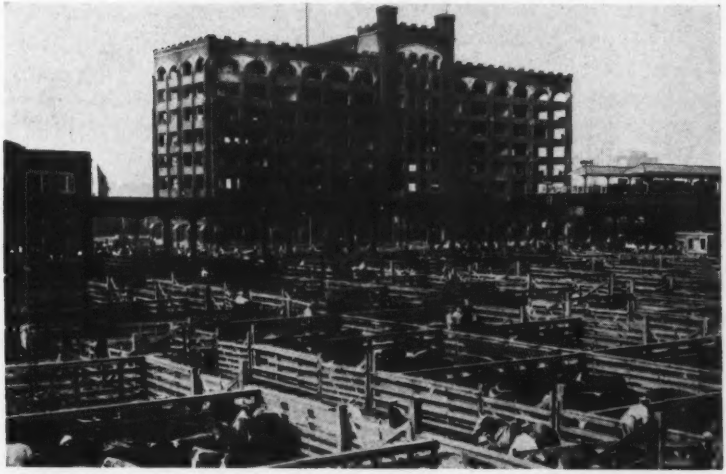
The principal buildings destroyed in this northeastern area were the extensive horse barns, the main pavilion, the buildings occupied by the Drovers Journal, the Mercury Manufacturing Company and the Omaha Packing Company, the quarters of Engine 59, the Drovers National Bank (with the exception of the vaults), and the minor mercantiles along the east side of South Halsted St. The steel trestle of the elevated railroad line extending into the stock yards section was very severely damaged for a distance of several hundred feet west of the South Halsted St. station. The contents of the fire-resistive Stock Yard Inn and the Breeders Building were destroyed and the buildings considerably damaged. The fire-resistive Live Stock National Bank building suffered moderate damage to building and contents.

The fire traveled west against the wind and by 5:30 P.M. had seriously involved a large 1-story frame shed, just east of the Armour and Company office building, and the 43rd St. frame viaduct. The fire was stopped at this point by effective operations of the Armour and Company private fire brigade, later assisted by the city department. Five hose streams were used from the private mains of Armour and Company and use also was made of the water curtain of open sprinklers installed on the east wall of the office building.

About 5:35 P.M. a vacant factory building at 3939-53 Union Ave., located about 900 feet from the main fire, was involved, probably by flying brands, but this fire was quickly surrounded and confined practically to the one building.

By 8:30 P.M. a material reduction in wind velocity was noted, and by about 11 P.M. the fire was considered under control. Considering the extent of the fire, there was comparatively little cleaning up left to be done by the fire department, so complete had been the destruction of all combustible materials in most of the buildings involved. The fire was finally "struck out" at 11:47 P.M. on Sunday, May 20, but a number of companies remained for several days to clean up, guarding against rekindling and removing dangerous walls.

The rapid spread of the fire is what might have been expected under unfavorable weather conditions in the maze of frame construction making up the pens and was further increased in the runways, hay barns, and viaducts. The lack of complete window protection on the Exchange Building may have contributed to its susceptibility, but temperatures involved in the fire were greater than wired glass ordinarily is intended to withstand. The performance



International.

Looking across the cattle pens north of Exchange Ave. after the fire. These pens are typical of those destroyed. In the background is the fire-resistive Exchange Building, which was completely gutted.

of this and the other fire-resistive buildings, was in general satisfactory structurally, and even the substandard protection of wire lath and plaster beneath trusses proved fairly effective in two cases. The extensive damage which may occur in structures with unprotected steel roof trusses was shown in the destruction of the main pavilion building. The one case where double standard fire doors were involved indicated their value as a fire stop. Except for a water curtain of open sprinklers, no sprinklers were involved in the fire.

This was the first conflagration in which the radio was used on a large scale as an aid in fire fighting. The broadcasts were effective in conserving water and in securing rapid response from off-shift members and outside aid. Radio service can be developed and organized further along these lines. The news feature of the broadcast was unsatisfactory. Lack of trained observers and suitable observation posts led to extremely exaggerated reports of the progress of the fire.

Fire Fighting Operations.

The first alarm for the fire was received from an American District Telegraph Co. (A.D.T.) fire alarm box at 4:21 P.M. This alarm was answered by 4 engine, 2 truck, 1 squad, 1 high pressure hose and 1 fire patrol companies in charge of two battalion chiefs and a division fire marshal. A 4-11 alarm was sounded at 4:26 P.M., followed at intervals up to 6:33 P.M. by 21 special calls for additional equipment and men. Fire department operations were under the direction of Fire Commissioner Seyferlich and Chief Fire Marshal

Corrigan. The total fire department response included 100 engine companies, 12 ladder trucks, 4 high pressure wagons, 3 water towers, 3 squads, 3 searchlight wagons, 5 ambulances, 3 gasoline supply wagons, and 3 fire insurance patrols; 4 suburban engine companies also operated at the fire.

General Tactics Employed.

The general strategy of the department consisted of an attempt to surround and confine the fire. After the first attempt in the pen area, three definite stands were made to the north and to the east in the path of the fire, the third of which proved successful.

The first alarm companies stretched single hose lines and worked on the fire until forced to retreat. Companies arriving later were able to make longer stands because of generally more favorable locations. Later, as the more definite stands were taken, water towers, high pressure wagons, and the turret nozzles on squad wagons were brought into position to furnish heavy streams. These were supplied by 2½-, 3-, and 3½-inch hose lines from the engines arriving in response to the numerous special calls. The use of nearly all types of fire department equipment and various arrangements of hose layouts were resorted to at different stages of the fire; long leads of hose were siamesed and relay pumping was resorted to where necessary to produce effective streams. Single lines were operated with 1⅛- and 1¼-inch nozzles; on deluge sets, and other heavy stream appliances, nozzle tips used were from 1½- to 2-inch.

Effective fire fighting in a fire involving such an immense amount of radiated heat and under such severe draft conditions necessitates the extensive use of heavy streams of water. Small streams are so quickly dissipated that they are valueless, and it was observed that even the larger streams used from the ground were so quickly broken up by the intense heat at some locations as to be ineffective. Water towers demonstrated their effectiveness by permitting the nozzle to be placed much closer to the seat of fire than is possible with ground equipment, thus preventing the breaking up and dissipation of the stream which occurs when streams must be projected considerable distances in extremely high temperatures.

Rescue Work.

At about 5:15 P.M. a heroic rescue was accomplished in removing four men trapped on the roof of the 8-story fire-resistive Exchange Building. At this time the fire had involved all floors, cutting off all means of escape. Their position was becoming unbearable on account of the excessive heat and smoke, and they were about to jump but were prevailed upon to wait until the 85-foot aerial ladder of Truck 4 was raised. This ladder reached to within three feet of the eighth floor window. Lieutenant Thomas Morrissey of Engine 65 climbed to the top of the ladder and entered through a window on

Associated Press.

The fire traveled west against the wind along the 43rd St. viaduct and threatened the office building of Armour & Co. Effective work on the part of the Armour fire brigade with streams from private mains, together with open sprinklers, stopped the fire at this point.

the eighth floor, followed by Firemen Joseph Reszal of Engine 2, John Tebbins of Truck 8, and Robert Quinn of Truck 14 carying a pompier ladder and a life line. Lieutenant Morrissey raised the ladder to the roof, ascended, instructed the four men, returned to the eighth floor, and held the ladder firmly in position while the four men, aided by the firemen, reached the ground in safety. During this time, streams of water were played on these men to protect them from the intense heat and flames radiating from the windows. Meanwhile, a life net was held in readiness below.

Casualties to Personnel and Damage to Equipment.

Fifty-four firemen received injuries at the fire, necessitating their absence from duty; of this number, 24 were taken to hospitals. Medical attention, consisting of treatment for burns, eye inflammation from intense heat and smoke, and heat exhaustion, was given to 132 firemen while on duty. During the fire many firemen drank water intended for the use of cattle only. About 26 firemen became disabled from the effects of this, necessitating their absence from duty, and about 100 others were somewhat affected.

Six pumping engines were either totally destroyed or badly damaged. Water Tower 1 and Ladder 15 were also badly scorched and damaged. The quarters of Engine 59 were destroyed together with all the equipment. About 35,000 feet of hose, much minor equipment, and some heavy stream appliances were also destroyed.

Private Fire Brigades.

The Armour and Company private fire department was assembled shortly after the fire started and laid five hose lines from their private system

Chicago Tribune.

Airplane view of ruins, looking west. In the foreground is South Halsted St. and ruins of Stock Pavilion and Stock Yard Inn. In the center are the fire-resistive Exchange Building and the South Exchange Building, the former gutted by the flames and the latter entirely destroyed.

of water mains, operating streams on the 43rd St. viaduct, the large frame shed east of their general office building, and on pens. The open sprinklers on the east wall of the office building also were used. Effective work was done by these men later, assisted by the city department, in stopping the fire before the office building was involved.

Several firemen and truck loads of hose from the G. H. Hammond Company's plant were held in readiness in case of necessity. Other firemen from private brigades aided in fighting the fire.

Fire Department Protection for the City.

Eleven engine, 8 combination engine and ladder, 2 booster, 2 fireboat, 35 ladder and 7 auxiliary squad companies were left in quarters to protect the city. Five extra engines from the repair shop and one from the drill school, together with nine other pieces of apparatus, were equipped at the repair shop for duty. Five of these extra engines were sent to the fire, while other apparatus, manned by off-shift firemen, was assigned to vacated stations.

A call was broadcast for all off-shift members of the fire department and retired members who were physically fit to report for duty. It is estimated that at least 90 per cent of the off-shift members and many retired firemen responded to this call. These men were assigned to various companies operating at the fire, and some were sent to fire stations occupied by out-of-town companies to act as supervising officers. The off-shift response was of great value in relieving the men exhausted by continuous duty under severe fire conditions.

Outside Aid.

As a result of the radio broadcast, assistance was sent from a number of neighboring cities and towns. Several of these companies worked at the fire, but, in most cases, they were directed to the nearest vacated fire station en route, so that unnecessary delay and travel were eliminated.

A total of 31 pieces of apparatus responded from outside cities and towns, four of which worked at the fire and the remainder "covered-in" at vacated stations. The value of this outside aid is indicated by the fact that fifteen alarms were answered during the stock yards fire by the out-of-town companies.

In addition to this out-of-town assistance that was utilized, Great Lakes, Illinois, sent two pieces of apparatus and 40 men, but on their arrival they were not needed and returned. A number of other cities and towns, including Detroit, Michigan, and Milwaukee, Wisconsin, proffered aid and stood by ready to respond.

No particular difficulty with varying hose threads was reported. Chicago and the majority of adjoining suburbs have a uniform thread varying slightly from "National Standard" but capable of being forced to it. The more distant municipalities generally have "National Standard" thread. Adapters for various size suction outlets are generally carried.

Water Supply.

While various estimates give the amount of water used as somewhat larger, it is believed that a maximum rate of about 50,000 gallons a minute was delivered by the fire department pumpers and by hose streams on the fire at any one time. No lack of water supply at hydrants was reported; two pumpers were used at most hydrants. A chart from a recording gage connected to a 12-inch main and located in the heart of the stock yards and packing house district, showed pressures of 28 pounds at 4:30 P.M., reducing to a minimum of 20 pounds at 6:30 P.M., and gradually increasing to 35 pounds at 11 P.M.

The total pumping rate for the whole city was near a maximum during the time of the fire. The maximum rate occurred between 6 and 7 P.M., when the total pumpage was at a rate of 1,306,800,000 gallons a day. The major portion of the water supply for the fire was furnished from the Western Ave. pumping station, located at 50th St., about two miles southwest of the fire area. Three of the four pumps, each of 75,000,000 gallons a day capacity, were in operation, and the fourth pump was ready to be started if needed; three of the four boilers were in operation and would carry the four pumps if necessary. At this station, pressures of 50 pounds were carried at 4 P.M. and gradually increased to 60 pounds at 10 P.M.

Hydrant distribution near the point of origin of the fire was wide; several hydrants along Exchange Ave. and to the south along 44th Place were

on 8- and 12-inch city mains and others were widely distributed on 4- to 12-inch mains of the private system. Distribution of city hydrants was good along South Halsted St. and to the east. As the fire progressed, fire department pumpers utilized the small reservoir of the private system at 41st and Morgan Sts. for direct draft.

The private water supply system of the Union Stock Yard and Transit Company was used by the fire department to some extent, particularly in the earlier stages of the fire, and was used throughout by employees and bystanders, with small lines for covering exposures and extinguishing small fires started by flying brands. Some fixed nozzles, forming water curtains, were opened and left running both near the fire and at greater distances from it. Connections to watering troughs in the pens were open throughout the fire.

Water department officials quickly realized the seriousness and the possibilities of the fire. Due to the hot, dry weather and the fire occurring at the time of day when lawn sprinkling produces maximum consumption rates, it was realized that in order to provide adequate quantities of water at sufficient pressure and supply ordinary consumption demands, the lawn sprinkling would have to be curtailed. Therefore, requests were made to radio stations to make appeals to consumers to shut off their lawn sprinklers and to otherwise conserve the supply. These requests were broadcast at about 5:00 P.M. and were repeated at short intervals. They were effective and the coöperation of the citizens was of considerable benefit and obviated the necessity of taking other emergency measures.

Losses.

Various estimates of the losses have been made, but final figures have not been determined at this time.

Reasonable estimates from reliable sources are as follows:

Property loss in yards about	$5,500,000.00
Insurance loss in yards about	4,500,000.00
Property loss outside yards about	500,000.00
Insurance loss outside yards about	350,000.00

Buffalo, N. Y., Malt Dust Explosion.

Report by D. J. Price,
(Member N.F.P.A.).

On Wednesday morning, January 24, 1934, about 1:27 o'clock, a fire was reported at the Kreiner Malt Company plant, 465-467 Spring Street, Buffalo, N. Y. The fire department responded promptly to the call, reaching the plant at approximately 1:30 A.M., and immediately began fire fighting operations. A short interval after water had been turned on, an explosion occurred, resulting in the death of Captain George H. Amos of Emergency Rescue Squad No. 2, and a civilian, and in injuries to fourteen firemen. The damage to buildings and contents was approximately $79,000.

William E. Kreiner and Sons, Inc., was established in 1878 as Kreiner and Lehr, and have been engaged since that time in the general malting and grain business. In addition to the Spring Street plant, the Kreiner Company operate another malt plant in Buffalo, which was erected in recent years and is of fire-resistive construction.

The plant at 467 Spring Street, in which the fire and explosion occurred, was built more than 50 years ago and was operated as a barley malting plant. The plant consisted of the following units:

1. MAIN BUILDING: This building was approximately 100 feet long by 48 feet in width, with four floors and basement, equal to five stories. Walls of brick construction up to the fourth floor and steel and composition-clad frame construction at fourth floor. The roof was constructed of 1-inch boards—metal or composition clad. The ground floors were concrete with non-combustible air ducts or tunnels located underneath in the sub-basement. The upper floors were constructed of 1-inch boards on joists, with part timber and steel supports. The third floor was covered mainly by 3-inch concrete. The stairs were part frame enclosed and open in the east end.

The air ducts or tunnels, with water-spraying equipment, were in the basement. The six malt "boxes" or compartments, about 30 feet by 13 feet 6 inches, were on the first floor. The six steel steep tanks and shipping machinery were on the second and third floors, with the malt, barley, and grain storage open-top frame bins on the top or fourth floor. The storage capacity was approximately 25,000 bushels.

2. KILN BUILDING: This building was about 40 feet by 33 feet. The basement and four stories were about 57 feet high; the frame ventilator reached to about 95 feet in

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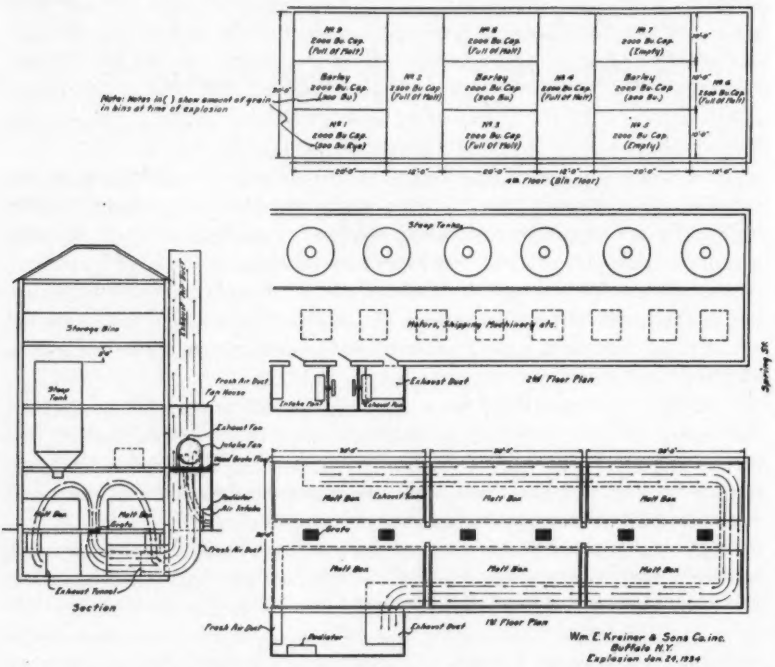
Dr. Price is Chairman of the N.F.P.A. Committee on Dust Explosion Hazards. As Principal Engineer in Charge, Chemical Engineering Division, Bureau of Chemistry and Soils, U. S. Dept. of Agriculture, he personally investigated this explosion. He wishes to acknowledge with gratitude the coöperation and assistance given in this investigation by officials of William E. Kreiner and Co., Inc.; Fire Commissioner W. R. Castimore and members of the Buffalo Fire Department; Supervisor J. J. Dwyer and members of the staff of the Federal Grain Supervision office; E. L. Ballard of the Eastern Underwriters Inspection Bureau; and other interested agencies.


Note: Notes in( ) show amount of grain in bins at time of explosion
No 9 2000 Bu. Cap. (Full of Malt)
No 8 2000 Bu Cap (Full of Malt)
No 7 2000 Bu. Cap. (Empty)
Barley 2000 Bu. Cap. (1000 Bu)
No 2 2000 Bu Cap (Full of Malt)
Barley 2000 Bu. Cap. (500 Bu)
No 4 2000 Bu Cap. (Full of Malt)
Barley 2000 Bu Cap (500 Bu.)
No 6 2000 Bu Cap. (Full of Malt)
No 1 2000 Bu. Cap. (500 Bu Rye)
No 3 2000 Bu. Cap. (Full Of Malt)
No 5 2000 Bu. Cap. (Empty)
4th Floor (Bin Floor)
Steep Tanks
Motors, Shipping Machinery etc.
2nd Floor Plan
Storage Bins
Steep Tank
Fresh Air Duct
Fan House
Exhaust Duct
Intake Fan
Exhaust Fan
Radiator
Air Intake
Malt Bin
Grate
Exhaust Tunnel
Section
1st Floor Plan
Wm. E. Kreiner & Sons Co. Inc.
Buffalo N.Y.
Explosion Jan. 29, 1934

height. The walls were of brick. The roof was of steel and composition on boards and joists, with large, high frame ventilator. The drier apparatus was installed in this building.

3. OFFICE BUILDING: This was a small, two-story frame structure between the brick walls of the main building and the plant of the Buffalo Forge Company, which adjoined on the north side.

4. FAN HOUSE BUILDING: This was a two-story frame steel-clad structure about 25 feet long by 10 feet wide, adjoining and communicating with the north side of the east end of the Main Building by means of three doors of frame construction on the second or first shipping floor.

5. MALT STORAGE BUILDING: This was a small, three-story building of frame, steel-clad construction adjoining the east side of the Kiln Building.

The Kreiner Company was engaged in general barley malting operations. The barley was transported by truck from the point of loading to the Spring Street plant, where it was weighed, elevated and stored in the customary manner by means of scales, receiving pit, elevator legs, conveyor lines and storage bins. There were three elevator legs in the plant, constructed of cypress wood, with standard rubber belt and metal buckets enclosed.

The malting process comprised the four usual operations: (1) steeping, (2) germinating, (3) kilning, (4) storage. The area in which the original fire and explosion occurred included the sections of the main building where the

steeping, germinating and storage operations were carried on. The kiln-drier building was affected only by the fire following the original fire and explosion.

The steeping operations were carried on in six steel steeping tanks, extending from the second floor up to within about three feet of the fourth floor. The "steeped" barley was discharged from these steeping tanks to the "compartment boxes" on the first or germinating floor.

The warm, moist air used in the germinating operations was drawn through the radiator in the fan house and discharged through underground water sprays, tunnels and ducts, through gate openings on the compartment or "box" floor. The air was then drawn through the barley in the compartment boxes and exhausted through an outside tower. The "malted barley," after passing through the germinating stages and drying operations, was taken by conveyor lines and elevator legs to the bins on the top floor of the main building for storage.

Story of the Fire and Explosion.

About 1:27 o'clock Wednesday morning, January 24, a fire alarm from 467 Spring Street was received at Buffalo fire department headquarters and two engine companies, a truck company, an emergency rescue squad and a battalion chief were immediately dispatched to the scene of the fire. Engine Company No. 3, in charge of Captain Raymond F. Schnorr, and Truck Company No. 3, in charge of Lieutenant Robert J. Zahn, Jr., reached the plant by approximately 1:30 A.M. The night watchman was waiting at the alleyway leading to the Spring Street entrance and took the firemen to the fan house, the point where he had discovered the fire when he pulled the private fire alarm box. The firemen found a fire burning on the inside of the fan house building. This fire appeared to be of small proportions. A water line was ordered, and while the firemen were engaged in bringing it from a hydrant on Spring Street, Captain Schnorr and the watchman went inside the main building, presumably to go to the upper floors to ascertain how far up the fire had extended.

In the meantime Battalion Chief Leo Considine arrived with Emergency Squad No. 2, in charge of Captain George H. Amos, and Engine Company No. 27, in charge of Captain Harold G. Rainey. These officers with their men entered the alley and had reached a point about halfway between the Spring Street entrance and the fan house, when the water was turned on to the fire in the fan house by Lieutenant Zahn and members of his company. A short time after the water had been turned on the fire an explosion occurred, and the flame from the fire flashed back through the fan house, burning Zahn and two of his men. Captain Schnorr and the watchman had reached the compartment box floor (first floor) and had observed considerable smoke on this floor, when the explosion occurred. Both men were blown down, but escaped with minor injuries. The explosion, which apparently occurred on the upper

Looking from Spring St. through alleyway, showing débris and grain, where body of Captain Amos was found. The fan house, where the fire started, may be seen in the rear.

floors of the main building, blew out the brick walls and caused the collapse of the roof and the entire upper part of this structure. Captain Amos, Battalion Chief Considine, Captain Rainey, Firemen Lucius Steele, George Jaman, Frank Diemer, and William J. Drummer were caught by the falling walls, the collapsed roof and flying débris, and were buried in the alleyway. Chief Considine, Firemen Jaman, Diemer, and Drummer, after releasing themselves with great difficulty, climbed up over the débris, broke a window leading into a toilet room at the rear of the Kreiner Company office, and escaped by means of a ladder from the office window. Captain Rainey, Fireman Steele and some of the other firemen were rescued near the Spring Street entrance. Captain Amos was completely covered by grain, débris and falling timbers, and his body was not recovered until about six hours later.

The body of a civilian was found underneath the débris on the sidewalk on Spring Street four days after the explosion. He was thought to have followed the fire engines to the plant and was caught by the falling débris when the explosion occurred.

Theories as to the Cause of the Explosion.

The investigation indicates that an explosion occurred on the upper floors of the main building a short time after the water was turned on the fire in the fan house. The relation of the turning on of the water to the explosion is the important aspect of this investigation. Whether or not the explosion would have occurred if the water had not been turned on is undetermined.

The explosion on the upper floors apparently originated in the storage section. It appears to have been an explosion of barley malt dust ignited in

some manner by the flames from the original fire. The results of the investigation can be summarized in the two possible theories:

1. The stream of water from the hose line used by the firemen to fight the original fire in the fan house struck the settled barley malt dust on beams, girders, ledges, and other parts of the upper floors and forced the dust cloud on to the burning fire, thereby causing a dust explosion.

2. The fire burned up through the wooden partitions of the fan house to the three wooden doors leading to the shipping room floor, then burned the wooden elevator leg near one of these doors. The fire entered the leg, traveled rapidly through the dust in the leg and through the conveyor over to the top storage bins on the top floor. This flash fire through the leg and conveyor to the bins forced the settled barley malt dust on top of the bins and in the storage section into suspension, resulting in a dust explosion.

In order for the explosion to have been caused by the water from the hose stream, it would be necessary for the stream of water to pass through the door openings at the top of the fan house, leading into the main building, and dislodge settled dust in the shipping and storage sections. This could have been possible, especially if the water struck the dust in the burning elevator leg, and since previous dust explosions have occurred in this manner during fire fighting operations, this is a possibility.

It appears more likely, however, that, owing to the combustible materials present, the fire in the fan house spread rapidly up to the upper floors and through the wooden doors leading into the shipping floor. This fire burned into the wooden elevator leg and flashed rapidly up through the leg to the conveyor line and over to the storage bin section. This fire flashing in and around the conveyor lines "blew" the settled dust around the storage bins into suspension, and this suspended dust cloud was ignited by the flames from the rapidly burning fire, resulting in a dust explosion in the storage section. This explosion blew out the brick walls of the main building, caused the roof to collapse, buried Captain Amos and resulted in his death, and injured the other firemen. The investigation indicates that the explosion may have been due to the ignition of barley malt dust in the storage section of the main building by the flames of the fire coming up into the storage section from the original fire in the fan house below.

Recommendations.

The investigation of this explosion has developed special conclusions that are of vital importance to barley handling, malting, and brewing operations.

(1) The conclusion that the explosion on the upper floors of the main building was due to the probable ignition of barley malt dust indicated the desirability of further explosibility tests of dusts produced in the handling and storage of raw barley, the handling and storage of malted barley, and the grinding of malted barley. Arrangements were therefore made to collect

General view of wrecked malting plant, showing damage to main building and west side of kiln building.

representative samples of barley and malt dusts in the various stages of handling, storage, and grinding. These tests have shown that these dusts compare favorably in explosibility with other kinds of grain dusts.

(2) This explosion emphasizes the importance of the malting industries becoming fully acquainted with the dust explosion and fire prevention research work of the Bureau of Chemistry and Soils in order that application can be made of methods that have been developed for dust explosion and fire prevention in other grain-handling industries.

(3) This explosion indicates the further possibility of malt dust explosions during malt grinding operations in the brewing industries, and emphasizes the importance of the brewing industries becoming fully acquainted with measures developed by the Bureau of Chemistry and Soils for dust explosion prevention during grain grinding operations.

(4) This explosion suggests the desirability of arranging for large-scale tests at the Arlington, Va., testing station of the Bureau of Chemistry and Soils. Representatives of the malting and brewing industries, insurance organizations, fire departments and other interested agencies could be invited to witness these tests and arrangements made for a round table conference at the time on dust explosion prevention, when specific consideration can be given to the dust explosion work of the Chemical Engineering Division of the Bureau.

The importance of a practical knowledge of dust explosion prevention by firemen is again suggested by this explosion in Buffalo. It is vitally important that special attention be given to the following points:

(a) Firemen in industrial centers where manufacturing plants are located should become thoroughly acquainted with the dust explosion prevention work of the Bureau of Chemistry and Soils. The various publications now available should be carefully studied, so that firemen may have a working knowledge as to what a dust explosion really is, the circumstances under which it can occur, and the methods to be followed for its prevention.

(b) Firemen should know about dust explosions that have occurred during fire fighting operations. The danger involved in the use of a heavy pressure stream of water in fighting fires in plants where combustible dusts are present should be fully recognized.

(c) The hazard from dust explosions in removing powdered materials from storage bins where fires have occurred, and the explosion hazard of near-by bins and enclosures containing combustible dust must be fully recognized.

(d) The value of periodical inspection of industrial plants where combustible dusts are created during manufacturing operations again suggests itself in the investigation of this explosion. Systematic inspection of this character enables firemen to become thoroughly familiar with structural conditions of the buildings and the hazardous manufacturing processes carried on in them. A definite knowledge of the contents of the buildings and of any combustible products handled and manufactured is secured. This knowledge is helpful in working out a plan of fire fighting with more adequate protection for the firemen.

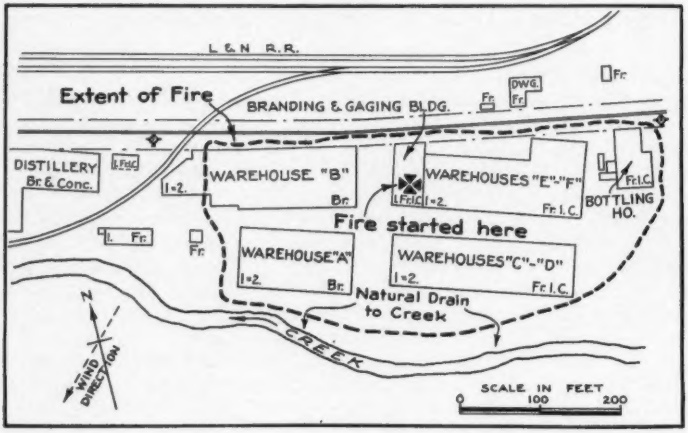
Lexington, Ky., Whiskey Warehouse Fire.

Report by Kentucky Actuarial Bureau,
(Member N.F.P.A.).

More than 15,000 barrels and 11,000 cases of whiskey were destroyed with a loss in excess of 2½ million dollars on April 28, 1934, when fire swept through four large warehouses at the James E. Pepper & Co. distillery just beyond the city limits of Lexington, Ky. The fire occurred when a watchman poured gasoline into his heating stove in order to quicken the fire. This act cost the watchman his life and started the fire which swept the plant.

This property was a large whiskey distillery and storage plant consisting of two brick-joisted warehouses, one empty and one containing bottled whiskey in cases; two frame iron-clad whiskey warehouses containing whiskey in barrels; a frame iron-clad bottling house and two small frame office buildings. A fire-resistive distillery building was under construction. All buildings were without automatic sprinkler protection. The warehouses were of the usual open rack whiskey storehouse construction. All four warehouses, the bottling house and their contents, were destroyed.

The plant was located beyond the corporate limits of the city, about 1¼ miles from the nearest fire department pumper. Two city hydrants were available on a long 6-inch looped main, located on the Old Frankfort Pike at distances of 35 feet from the bottling house and 50 feet from Warehouse "B."



There was no private protection at the plant. Watchman service with approved portable clock was maintained, covering outside of buildings only, except for watchman's office in the north end of Warehouse "E"-"F" (see diagram).

Story of the Fire.

The night of the fire was cool, and after finishing his midnight round the watchman proceeded to kindle a quick fire in the stove in his office in the branding and gaging building. He poured what he thought to be kerosene on the wood in the stove, but the liquid proved to be gasoline which had been left in the office by tinners. When the match was applied to the gasoline-soaked wood, an explosion occurred which wrecked the stove and emitted a burst of flame, fatally burning the watchman. The watchman, his clothing aflame, ran from the building and fell unconscious before he could sound an alarm. He was discovered about an hour later halfway down the alley between Warehouse "A" and "B" and removed to the hospital. Before he died, he recovered consciousness long enough to tell how the fire started.

The fire, feeding on the readily combustible wooden construction, gained headway rapidly, and the flames, breaking from the north end of the building, were noticed by the watchman at a neighboring plant. He turned in an alarm which was recorded at 1:11 A.M. The watchman at another near-by plant discovered the fire at about the same time and turned in an alarm which was recorded at 1:12 A.M. Two 750-gallon pumpers of the Lexington fire department responded at once, but by the time they arrived the fire had already spread to Warehouse "C"-"D" and both were entirely involved, the roofs collapsing a few minutes later.

The firemen used five lines of hose from the two pumpers and the main supplied enough water for these streams, but they had no appreciable effect.

General view of the ruins from the north, showing complete destruction of frame iron-clad warehouses and walls of brick warehouses still standing.

The intense heat soon ignited the wooden monitors of the two brick warehouses and worked down into the interior of these buildings. It also spread to the wooden bottling plant, all these buildings being destroyed within three hours. Streams of burning whiskey flowed from the warehouses, forming a blazing pool in a depression near the creek bank, where it continued to burn for several hours more.

Loss.

Everything combustible was consumed, only twisted metal, brick, stone and ashes remaining. According to records of the company, there were, at the time of the fire, 10,378 barrels of bonded whiskey in Warehouse "C"-"D," 5129 barrels of bonded whiskey in Warehouse "E"-"F," 12,749 cases of bonded and 244 cases of "free" whiskey in Warehouse "B." Warehouse "A" was empty. Except for about 750 cases of whiskey, the loss, which was settled for $2,655,467, was total.

Looking northwest between Warehouses "A" and "B." Wooden shutters were tin-clad on outside only.

Fire Record of Idle and Vacant Property.

The problem of idle and vacant property as a community fire hazard has always been a factor in the field of fire prevention, regardless of economic conditions. It has been accentuated during this period of decreased business activity. Many industrial establishments, their output decreased, have consolidated their plants or have gone out of business entirely, with the result that in most large cities and many smaller communities buildings used for manufacturing purposes have been left vacant. Even with the revival of industrial activity there are many vacant and obsolete buildings left, and structures of this type, unless properly maintained and cared for, present a serious individual and community fire hazard.

The files of the Department of Fire Record of the National Fire Protection Association contain reports on two hundred and sixty-four fires in idle and vacant property, and while approximately sixty per cent of them involve monetary losses of less than $25,000, it will be noted that sixteen of them, involving an aggregate loss of more than five million dollars, caused serious loss to property other than that in which the fire originated, and at least five of them were of conflagration proportions. In compiling this record, all fires in idle and vacant property reported to this Association from 1908 to date have been included.

The primary purpose of this record is to point out from actual fire experience the potential fire hazard incidental to idle and vacant property and to emphasize the need for proper safeguards. The desirability of maintaining private protection features, even after demolition of an old, unused plant has been started, is clearly indicated.

The record is obviously by no means complete and does not include many fires in this class of property which have occurred from time to time, but have not been reported to the various inspection bureaus. In this record insurance inspection bureau reports are the source of data on most of the fires recorded. No attempt has been made to obtain data on the many fires in vacant dwellings and mercantile establishments which have been so prevalent in most cities and towns during the past three years of acute economic depression.

Elimination of Conflagration Breeders.

The problem of the idle and vacant building from the municipal point of view is being solved in a number of cities by wholesale condemnation and demolition of such property by municipal authorities. This action is clearing out many breeding places for potential conflagrations and at the same time providing employment for a considerable number of men. Private owners and

An abandoned coal pocket on a piece of wharf property where a serious fire had occurred three years previous. The ruins of this fire were never cleaned up and the unburned portion of the structure was in a dilapidated condition when this picture was taken. Buildings of this sort are conflagration breeders and seriously jeopardize the fire safety of the entire community.

fire insurance interests have coöperated in many instances with city authorities in maintaining adequate protection for vacant property and safeguarding, in so far as possible, the processes of demolition of obsolete buildings.

It is significant that of the total loss reported to the N.F.P.A. Department of Fire Record from fires originating in idle and vacant property from 1908 to date, but thirty-five per cent was to the building or property in which the fire started. Sixty-five per cent of the loss was to exposed property.

An interesting example of the maintenance of proper safeguards against a serious conflagration hazard presented by a large vacant property is indicated by the procedure followed in one New England city. When all fire insurance was canceled by the owners in October, 1932, and private fire protection equipment shut off, this plant, consisting of a group of wooden buildings with oil-soaked floors, became a serious fire menace to adjacent industrial plants and other property. The owners of the exposed plants were appealed to and with their coöperation, and that of others interested, arrangements were perfected for the restoration of as much as possible of the fire protection of the abandoned plant.

As winter was approaching, the sprinkler systems in all the buildings could not be left in service. The existing dry pipe systems were filled with air and the dry pipe valves were set. Water pressure was admitted to the yard mains, so that sprinkler protection would be available for the other buildings by opening the post indicator valves in event of fire. Conditions were explained in detail to the watchmen and the city fire department. One near-by plant provided a power line for the operation of the air compressor at the

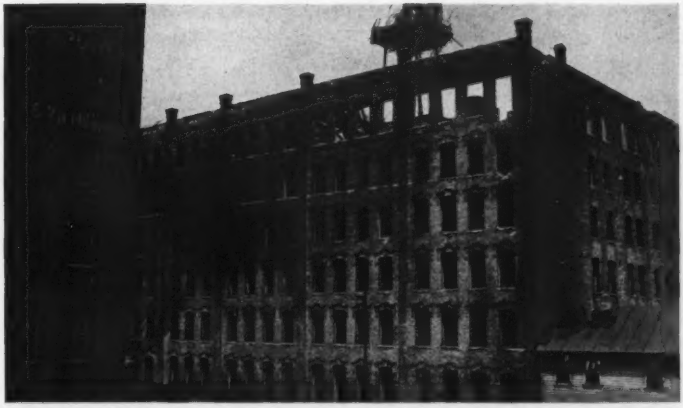
abandoned mill in order to maintain pressure on the dry pipe system. Lanterns and oil were provided for heating the dry valve enclosures. The watchman on duty during the daytime maintained the air pressure in the system and kept the lanterns filled.

When spring came the dry pipe valves were tripped and the control valves to the other sprinkler systems were opened to provide protection for all buildings of the plant during the summer months, and in October, 1933, the system was again put in service for the winter. By the spring of 1934, however, the settling of the roofs, leakage of old valves and the general depreciation of the buildings made it extremely difficult, if not impractical, to continue to maintain fire protection. With no protection, this abandoned property again became a serious conflagration menace.

This picture indicates the proper maintenance of protection during the dismantling and razing of a large mill. The open sprinkler valve controls a four-story dismantled building, a typical floor being shown below. Sprinklers are shut off floor by floor as the work proceeds, thus safeguarding, as long as possible, near-by properties against a possible exposure fire.

Factory Mutual Record.

The attention of city officials was called to the situation and at a meeting which was held at least two local manufacturers expressed the opinion that their plants would not be rebuilt should they be seriously damaged by an exposing fire. The complete demolition of the plant appeared to be the only satisfactory plan to safeguard the operating industries, and the community itself, against the severe hazard. The city had no legal authority to condemn



Factory Mutual Record.

This fire is typical of the serious exposure hazard created by large abandoned plants of combustible interior construction. Most of the doors and windows of this building had been removed, sprinklers had been disconnected, the tank was empty, and vandals had torn out most of the wooden stairways and parts of the floors, leaving large unprotected vertical openings. Open sprinklers were an important factor in keeping the fire from the exposed plant at the left of the picture.

buildings, but it was pointed out that if an agreement could be reached between the owners and the city, the removal of the buildings would be a suitable unemployment project and the city could use the building material.

As a result of this meeting the owners decided to demolish the buildings, thus saving an annual city tax of $33,000 and eliminating the necessity of maintaining constant watch service. This demolition is now in progress. Automatic sprinkler protection is being maintained in all buildings except in areas where actual demolition operations are taking place. Sprinkler risers are capped at each floor as buildings are torn down and protection is maintained on the rest of the property. One building is removed at a time. Driveways are kept open and material is removed as rapidly as possible. Watch service is maintained night and day and watchmen are familiar with the fire protection equipment available. Smoking is prohibited and the fire department has detailed a man to keep a watch on the hazard.

N.F.P.A. Fire Record.

In view of the character of the original data, which include most of the larger and more important fires but not a fair proportion of the smaller fires (particularly in mercantile property), this record may not be completely representative. The record, however, includes a sufficiently broad selection of important fires so that there can be no question as to the validity of conclusions drawn.

For the most part, the fires in idle and vacant property included in the N.F.P.A. fire record have occurred in buildings previously occupied for manufacturing purposes, 194 out of 264 fires being so recorded. Details of occupancy are indicated by the following table.

Occupancy of Buildings.

	No. Fires	No. Fires
Manufacturing Occupancies		194
Textile working plants	32	
Metal working plants	30	
Shoe and leather workers	30	
Woodworkers	17	
Breweries	16	
Food products	12	
Paper working plants	6	
Chemical works	5	
Miscellaneous known occupancies	28	
Exact occupancy unknown	18	
Other Occupancies		52
Mercantile establishments	12	
Hotels	7	
Warehouses	7	
Laundries	4	
Theatres	3	
Piers and wharves	3	
Miscellaneous known occupancies	16	
No data as to occupancy		18
Total fires		264

A considerable proportion of the buildings involved in the fires covered by this record were of wood and practically all had wooden interior construction. The four fires in fire-resistive structures were controlled in each instance with but moderate damage.

Construction of Buildings.

	No. Fires
Frame	96
Brick or stone, joisted	95
Brick mill	20
Brick or stone and frame	10
Fire-resistive	4
Frame, iron-clad	2
No data as to construction	37
Total	264

The complete destruction of many of the buildings in these fires may undoubtedly be charged to neglected and combustible construction features of the interiors, even though not so specifically stated in the original reports. Excessively dry or oil-soaked flooring, absence of, or defective protection for,

International.

Oil-soaked floors facilitated the spread of this noontime fire, started by an acetylene torch in a vacant warehouse building. In spite of the fact that a fire station housing two engine companies was located in the next block (see picture), the fire, starting on the first floor, gained sufficient headway to necessitate several additional alarms. This picture shows the fire in its later stages. Note concentration of apparatus and hose streams required to bring it under control.

horizontal and vertical openings, structural failures and impairment of fire protection features all contributed to the rapid spread of fire. These fires were difficult to control, even where an efficient fire fighting force and adequate water supplies were available.

Forty fires were discovered by watchmen. Twenty-three of these occurred after seven o'clock in the evening and prior to seven o'clock the next morning, and eight occurred during the day. In nine fires the time of discovery was not reported. Twenty-four of the fires discovered by watchmen involved losses reported as small or under $1000, three involved moderate losses, and thirteen involved losses reported as large or over $5000.

How the Fire Was Discovered.

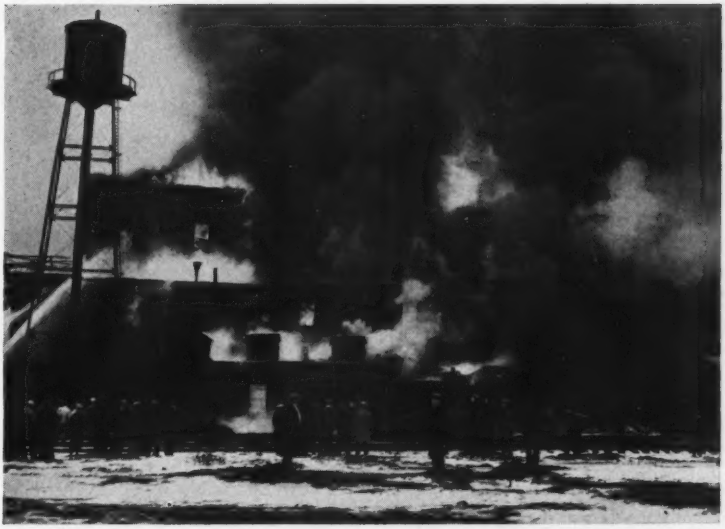
	No. Fires
Outsiders	137
Watchman or caretaker	40
Employees or workmen	40
Sprinkler alarm	26
Thermostats	3
Thermostats and sprinkler alarm	1
No data as to manner of discovery	17
Total	264

Sprinkler alarms gave first notification in twenty-six fires, of which ten occurred during daytime and nine at night. The time of seven other fires was not reported. Small losses were reported for twenty-two of these fires, and moderate losses for three others. In one fire the loss was principally due to the large quantity of combustible materials in the building.

Thermostats were responsible for the discovery of three night fires, and losses were small in two instances. One large loss fire discovered by thermostats occurred when lightning set fire to the engine room of an unused mine. Sprinkler and thermostat alarms together gave notification of one night fire which was controlled with slight loss.

Causes of Fires in Idle and Vacant Property.

	No. Fires	Per Cent of Known Causes
Smoking—matches	28	15.8
Incendiary	25	14.1
Use of acetylene or gasoline torches	17	9.6
Vagrants in unoccupied buildings	15	8.5
Exposure	13	7.3
Spontaneous ignition	11	6.3
Boys and matches	11	6.3
Electrical causes	8	4.5
Sparks from bonfires	7	3.9
Sparks from chimneys	6	3.4
Sparks from locomotives	6	3.4
Ignition of rubbish and litter	6	3.4
Miscellaneous known causes	24	13.5
Total known causes	177	100.0
Unknown causes	79	
Unknown—suspicious	8	
Total fires	264	



Wm. E. Patterson.

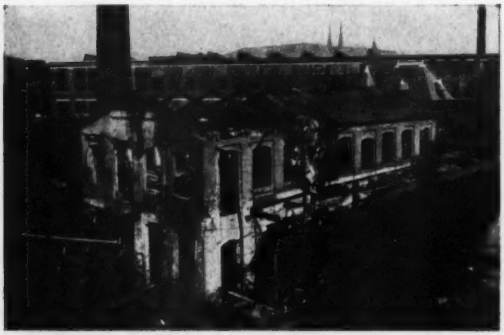
Sparks from an acetylene torch used in dismantling equipment in an abandoned plant in Pittsburgh, Pa., on Feb. 2, 1934, ignited combustible debris and resulted in a fire which required fourteen hours to subdue. The sprinkler system had been partially removed prior to the fire. Oil-soaked floors contributed to the spread of the flames, which virtually destroyed the plant.

The foregoing table of causes indicates that, as in many other occupancies, the careless disposition of smokers' materials is a serious potential fire hazard. An analysis of the fires indicates that many of these fires were due to carelessness on the part of trespassers and loafers who discarded cigarettes and/or matches in the buildings or threw them through unprotected gratings or other openings.

Incendiarism as a fire cause in vacant property is indicative of the temptation on the part of unscrupulous individuals to "sell out to the insurance companies." Only the fires definitely reported as chargeable to this cause have been so included under this classification. Without doubt, many of the fires classified as "unknown origin" may well belong to this group.

The use of acetylene or gasoline torches in dismantling operations was responsible for seventeen fires. The use of such equipment in buildings where oily floors and accumulations of rubbish are present is always hazardous, and special safeguards should be taken to prevent stray sparks from torches igniting combustible material.

Tramps and vagrants use idle and vacant buildings for refuge from the weather during winter months. These men often build fires inside the buildings, even on wood floors, for warmth and cooking purposes. They smoke



Factory Mutual Record.

This fire was started by a cutting torch, but the loss was due to shut-off sprinkler protection.

carelessly, and use matches indiscriminately. Fifteen fires in the record can definitely be attributed to the presence of such vagrant occupancy of buildings.

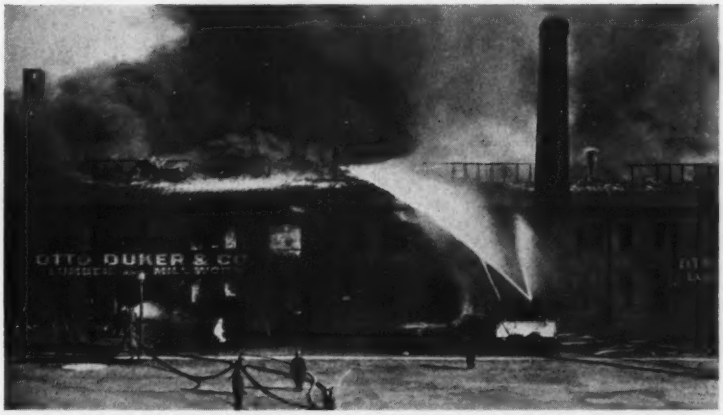
A building which is allowed to deteriorate falls easy prey to fire. With windows broken and exterior openings unprotected, sparks from locomotives, near-by chimneys or brands from a near-by fire are more apt to set fire to a building in poor condition. Grass and weeds around a building present another serious hazard. Thirteen fires in the record were due to exposure, sparks from bonfires accounted for seven, and six each were chargeable to sparks from locomotives and from chimneys.

Spontaneous ignition accounts for eleven fires as follows: oily material (4), lacquer residue (1), buffing dust (1), chemicals (1), match splints (1), cork (1), waste paper (1), unknown (1).

Analysis of Loss—Vacant Property.

The following table shows a summary of losses for idle and vacant property as reported to the N.F.P.A. Department of Fire Record. The figures included in the table cover both the loss to the building of origin and the loss to property exposed to and damaged by the spread of the fire to other property.

Loss	Sprinklered Fires	Sprinklered Per Cent	Unsprinklered Fires	Unsprinklered Per Cent	Total Fires	Total Per Cent
Small loss (under $1,000)	70	66.1	27	17.1	97	36.7
$1,000 but under $10,000	11	10.4	27	17.1	38	14.4
$10,000 but under $25,000	3	2.7	18	11.4	21	7.9
$25,000 but under $100,000	5	4.7	34	21.5	39	14.8
Over $100,000	4	3.8	12	7.7	16	6.0
Moderate (no figures available)	8	7.5	4	2.5	12	4.7
Considerable (no figures available)	2	1.9	14	8.8	16	6.0
Total (no figures available)	1	1.0	17	10.7	18	6.8
Large (no figures available)	2	1.9	4	2.5	6	2.3
No data as to loss	..	...	1	.7	1	.4
Total fires	106	100.0	158	100.0	264	100.0



Acme.

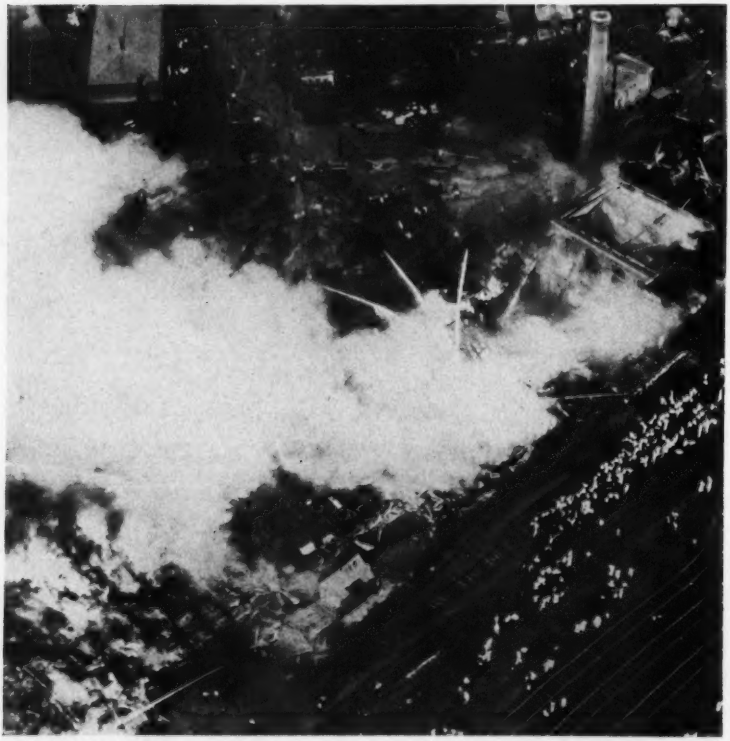
View of fire in Baltimore, January 27, 1932, showing intense fire which started in a vacant furniture factory where sprinklers were shut off. The furniture factory, near-by lumber piles, and part of a large lumber yard across the street were destroyed, with a loss estimated to be about $200,000. More than 60 hose streams were used to bring this fire under control.

Further analysis of 144 fires in the N.F.P.A. records where definite loss figures are reported indicates an average loss per fire of $31,852 for fires in which sprinkler systems were a factor, and $73,000 for fires in property not so equipped. This comparison is not entirely fair in view of the fact that in the case of 50 fires in sprinklered property and 14 in unsprinklered property the loss was reported as trifling or slight, without definite stipulation as to loss in dollars and cents.

Comparison of Losses—Sprinklered and Unsprinklered Buildings (including losses on exposed property).

Loss	Sprinklered Property			Unsprinklered Property		
	Fires	Total Loss	Loss per Fire	Fires	Total Loss	Loss per Fire
Loss under $1,000	20	$4,251	$212	12	$3,751	$312
Loss $1,000 to $4,999	5	9,936	1,987	16	45,579	2,848
Loss $5,000 to $9,999	6	44,618	7,436	12	76,035	6,336
Loss $10,000 to $24,999	3	51,000	17,000	18	282,745	15,600
Loss $25,000 to $49,999	3	93,600	31,200	18	596,040	32,558
Loss $50,000 to $99,999	2	132,500	66,250	13	822,923	63,379
Over $100,000	4	1,033,750	258,440	12	5,543,800	462,000
Total fires of known loss.	43	$1,369,655	$31,852	101	$7,370,873	$73,000

Sixteen fires, or approximately 6 per cent of the total number, extended beyond the property of origin. The total loss involved in these sixteen fires was $5,672,651, of which $349,980 was to the property of origin and $5,322,071 was to exposed buildings and contents. The total loss in these sixteen fires represented 65 per cent of the total known loss for all fires in idle and vacant property indicated by the foregoing table.



Factory Mutual Record.

Hose streams playing on ruins of 5-story wooden factory at Lowell, Mass. Although starting in broad daylight, this fire gained such headway that firemen from a station only a block distant were unable to approach the building to turn on sprinklers, which had been shut off due to freezing. Near-by wooden buildings caught fire and were destroyed, and more than a score of fires were started on wooden shingle roofs by flying brands.

Seventy-eight fires, or approximately 30 per cent, involved a total loss to property in which they originated. Ten of these fires were in sprinklered property, and sixty-eight were in property without automatic sprinkler protection.

Fire Record of Vacant Sprinklered Property.

This record comprises a total of one hundred and six fires in idle and vacant property in which automatic sprinkler systems, in whole or in part, had continued to be maintained. Thirteen of these fires were of such character and location that no sprinkler heads operated. As might be expected, the number of fires in which the operation of the sprinklers has been classed as unsatisfactory is proportionately greater than in most active occupancies. This was principally due to the fact that the systems had been shut off for one

reason or another, and while the heads functioned satisfactorily no water was available in the system for fire extinguishing purposes.

Sprinkler Fire Record.*

	Vacant Buildings		All Classes	
	No. Fires	Per Cent	No. Fires	Per Cent
Extinguished fire	47	50.6	37,134	69.5
Held fire in check	15	16.1	14,123	26.5
Total satisfactory control	62	66.7	51,257	96.0
Unsatisfactory	31	33.3	2,166	4.0
Total sprinklers operating	93	100.0	53,423	100.0
Sprinklers not a factor	13			
Total	106			

The reasons for the unsatisfactory operation of sprinklers in thirty-one fires were reported as follows:

	No. Fires
Water shut off sprinklers	23
Shut off to prevent freezing	7
Shut off due to vacancy	7
Shut off for incendiary reasons	3
Shut off, reason unknown	6
Sprinklers crippled by freezing	3
Generally defective equipment	1
Faulty building construction	1
Obstruction to distribution	1
Exposure or conflagration	1
Plugged heads	1
Total	31

Typical Fires in Vacant Property.

The following brief summaries of typical fires in idle and vacant property have been selected as indicating some of the factors that have been responsible for such fires. Several fires indicative of the potential conflagration hazard of unoccupied property are included.

Fire Protection Equipment Removed.

FALL RIVER, MASS., FEB. 2, 1928. Six blocks in the heart of the city were wiped out in a conflagration which started in one of a group of vacant mill buildings of heavy timber construction which were being demolished. The upper floors of two of the buildings had already been taken down and the automatic sprinkler piping and fire doors had been removed from the entire property. Holes had been cut through the floors for the purpose of removing machinery. The weather was cold at the time, and on the day of the fire workmen had heating fires in various parts of the buildings. One of these heating fires was in an improvised salamander made from an empty fifty-

*It will be noted that the figures in the above table do not agree with the figures in the annual sprinkler tables published in the April, 1934, QUARTERLY. This is due to the addition of fire reports which have been received since the compilation of the annual tables.

The Fall River conflagration of 1928. The vacant mill where the fire started is at the extreme left of the picture.

gallon steel oil drum located on the ground floor. This steel drum rested directly on the wooden floor and the heat therefrom ignited the floor directly beneath it.

The workmen left the premises, which were without watchman protection, at 5 P.M. About an hour later an unusual light was noted in the building and after some delay, incidental to investigation, an alarm was turned in. The fire department responded promptly and stretched two or three lines of hose to combat the fire, which at this time did not appear to have reached serious proportions. Within a few minutes, however, the fire reached a belt tower which communicated with all floors of the mill. This allowed unrestricted spread of fire, and soon the entire building was a mass of flames and the fire was beyond control of the local fire department.

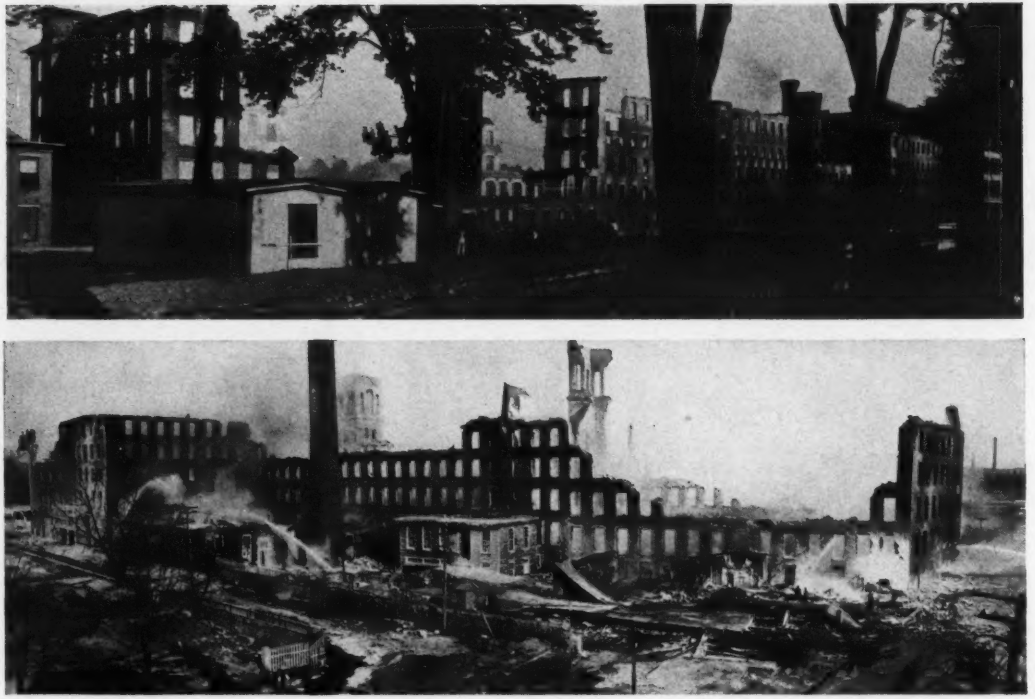
A high wind and near-zero temperatures combined to make fire fighting difficult, and the fire swept unchecked into the near-by business district. There were very few fire stops in the form of fire-resistive buildings, effective fire walls, or buildings with automatic sprinkler protection in the burned area. The majority of the structures destroyed might have been described as "built to burn." The spread of the fire to the north and south was finally checked at buildings with substantial fire-resistive walls and automatic sprinklers. On the east the fire was stopped in the middle of a block of frame "fire traps" through remarkable work on the part of the firemen.

The total loss in this fire was in excess of $2,500,000, of which approximately $54,500 was on the property in which the fire originated. (H-25753.)

SOMERSWORTH, N. H., SEPT. 8, 1930. This fire involved an old abandoned 6-story cotton mill of heavy timber construction which severely exposed other buildings of the plant at either end. The abandoned building in which the fire started was in process of demolition. All machinery had been removed, the sprinkler system had been taken out and some of the plank flooring had been torn up. The first floor was being temporarily used for storage of some used looms.

A trace of smoke was noticed by the watchman as early as 11:30 the evening previous to the fire. Failing to find any fire, he assumed the smoke came from a rubbish fire in the yard and made his next two hourly rounds. On his last round at 1:30 A.M., he discoverd a brisk fire in some baled waste paper on the first floor. Following instructions, the watchman opened the yard gate and rang the bell on the top of the abandoned mill. He then ran to the yard and shouted to a policeman, who turned in a public alarm. Meanwhile, about twenty minutes had elapsed. The mill and public fire department responded promptly and soon had hose streams in operation.

The fire spread rapidly through the old mill along the dry and somewhat oil-soaked floor. The firemen, realizing that the abandoned mill could not be saved, concentrated their efforts on protecting the buildings at either end of



Factory Mutual Record.

Two idle and vacant mill fires. Above: Somersworth, N. H., mill. Below: Merchants Mill, Fall River, Mass.

the burning structure. Aid from other towns was summoned, and soon fifteen streams were in use, six from two mill fire pumps and the remainder from the public water mains and fire department pumpers taking suction from city hydrants and the near-by canal.

Good work was done by the fire department, for although the temporary end of a concrete mill adjacent to the fire was of wooden construction and only fifty feet away, it suffered but slight damage. The brick wall of the storehouse facing the other end of the burned mill was blank. A wooden cornice thereon was so well protected with hose streams that it did not ignite. By noon the mill and contents were totally destroyed, only the brick walls remaining. (H-30424.)

Careless Use of Acetylene Torch.

PITTSBURGH, PA., FEB. 2, 1934. A spectacular daytime fire which called for five alarms before it was brought under control broke out in a large three-story brick factory building of heavy timber construction. The building, which had been used by the Crucible Steel Company as a pottery factory, had been abandoned and was being dismantled.

Acetylene torches were being used to cut up the machinery, shafting and other steel work in the building when the fire was discovered by workmen, who noticed smoke coming up through the heavy oil and grease soaked floor. One of the men pulled up a section of the flooring and as he did, a sheet of flame burst through the opening. It was only a few minutes before the building, covering almost an entire block, was a mass of flames, so quickly did the flames spread, aided by the draught created by the opening made by the workman. It is believed that the fire was due to a spark from an acetylene torch falling into combustible material in the basement.

While some of the workmen tried to extinguish the fire with a fire extinguisher, one of them ran to a fire alarm box and sent in the first alarm, which reached the fire department at 9:14 A.M. When the first fire companies arrived on the scene the workmen had been driven out of the building by the flames and serious fire was already in progress, with the flames threatening to spread beyond the burning building and across the street and the railroad right-of-way to other large manufacturing plants. Fourteen pumper streams and five hydrant streams were used in controlling and extinguishing the fire, which lasted fourteen hours. (H-37779.)

Sprinklers Disabled Due to Freezing.

LOWELL, MASS., JUNE 25, 1933. This fire started from an undetermined, and possibly incendiary, origin in the first floor of a vacant five-story wooden factory formerly occupied by a wood heel manufacturer. This building was sprinklered, but pipes had frozen and broken during the previous winter, and the system had since been shut off at an inside valve.

Although the building had plank-and-timber floors and roof, the floor

The start of the Newburyport, Mass., fire of May 19, 1934. This picture, taken approximately fifteen minutes after the first alarm, shows the headway of the fire in the large area 5-story wooden factory, where it originated. Sprinklers had been shut off to prevent freezing during the past winter and protection had not been restored.

cut-offs were poor and incomplete, so that the fire, which had obtained considerable headway prior to its discovery, spread quickly from floor to floor. When the first fire company, only a block away, arrived, several stories of the building were completely involved. The firemen had standing orders to open the inside sprinkler valve in event of fire in the building, but the heat was so great that they could not approach the structure. The available hose streams were entirely inadequate to cope with the fire then in progress.

Intense radiated heat, aided by a brisk wind, ignited a near-by group of wooden dwellings, creating conditions favorable for the development of a conflagration, for directly in the path of the fast-spreading fire was a large wooden church in the midst of a congested district of wooden houses; and burning brands carried by the wind set fire to at least twenty wooden roofs.

Outside aid was summoned to the assistance of the local fire department, and at the height of the fire fourteen pumpers with thirty hose streams were fighting the main fire, and about seven pumpers and other apparatus were working on scattered roof fires.

In spite of the seriousness of this fire, the total loss was estimated at only $150,000 because the factory where the fire started was vacant, the eight dwellings destroyed were of moderate value, and the scattered fires in dwellings were confined mostly to the roofs. (H-36701.)

Sprinklers Shut Off.

WATERBURY, CONN., MARCH 22, 1931. Workmen were dismantling equipment in a vacant plant preparatory to razing the buildings, which had been vacated about three weeks previous. At that time sprinklers had been shut off and steam was no longer maintained on the fire pump.

A contractor's workman was using an acetylene torch to cut away a pulley under the wooden roof trusses of a large one-story brick building. Two other men stood by with chemical extinguishers and pails of water. A spark from the torch ignited the oil and dust on the pulleys and trusses, and a flash of fire trapped the workman in an awkward position under the roof. The other men dropped their extinguishers to rescue him, and the fire, aided by a draft through open windows and doors, spread rapidly through the dust-covered, well-seasoned roof beams and trusses.

An unsuccessful attempt was made to check the fire with a hose stream from the yard hydrants. After some delay an alarm was sounded, but when the fire department arrived the fire had spread into two adjoining buildings. The roofs of two large one-story buildings were destroyed and a two-story brick building and other smaller structures were completely gutted.

The controlling valves of the sprinkler system were opened and closed several times during the fire, but the sprinklers were ineffective because water wasted through a 3-inch pipe which had been disconnected several days previous, and through other smaller pipes which had frozen and broken. Had sprinklers been in service they undoubtedly would have controlled the fire at the start. (S-32647.)

NEWBURYPORT, MASS., MAY 19, 1934. The recent serious fire which involved a group of thirty buildings and threatened to reach conflagration proportions emphasizes the potential conflagration hazard of idle and vacant property, as well as pointing out the inadvisability of shutting off sprinklers in such property.

This fire, probably of incendiary origin, started at 1:24 A.M. in the stair and elevator tower of a large area 4-story wooden shoe factory which had been vacant since 1929. The building was equipped with automatic sprinklers, but the water had been shut off during the winter months and had not, as in previous summers, been turned on due to the fact that the property was soon to be razed to make way for a highway project.

The fire had gained considerable headway before the alarm was sounded, and within a very few minutes the entire building was ablaze. Within twenty minutes, and before effective streams could be brought into play, the flames, driven by a strong wind, crossed a ninety-foot open space to attack a 5-story brick-joisted sprinklered shoe factory, which was totally destroyed. The sprinkler system in this latter building was in operative condition, but the exposure was extremely severe and the available water supply, other than a 15,000-

International.

Airplane view of the Newburyport fire ruins, showing complete destruction of buildings involved. The fire started in a vacant wooden shoe factory (1), and within twenty minutes had involved the 5-story brick sprinklered building (2) across a 90-foot open space to the south.

gallon gravity tank on the roof, was probably depleted by fire department pumpers taking suction from the street main in front of the building.

The fire swept through a considerable number of lesser structures, mostly of frame construction in the vicinity, and flying brands were responsible for approximately forty minor fires on wooden shingle roofs and awnings within a radius of a mile and a half from the main fire. The total loss was estimated in the vicinity of $400,000. (H-38096.)

Vagrants in Vacant Buildings.

FALL RIVER, MASS., JAN. 29, 1934. This fire involved an old cotton mill which was liquidated several years ago. It consisted of a large 5-story stone mill 580 x 92 feet with a similar building of somewhat less area adjoining. Sprinkler piping was in place, but the sprinkler heads had been removed. Windows were broken, fire doors and doors at stair enclosures were in poor repair and missing, and belt enclosures were open. There had been difficulty in keeping trespassers out of the buildings and it was the practice of vagrants to use the premises as sleeping quarters from time to time.

On the morning of the fire the temperature was just above zero, and the wind at times reached almost gale proportions. Tramps had apparently taken shelter in the mill, built a fire to keep themselves warm, and carelessly left the fire smoldering. About 9:15 o'clock smoke was noticed coming from the second and third story windows at one end of the building, and the fire department was summoned.

Because of the smoke, firemen could not enter the building. The fire made rapid headway along the oil-soaked floors and extended upward through the unprotected openings to the roof. Hose streams were applied from three sides of the mill buildings, but the fire was so rapid, the volume of burning material so large and the amount of heat generated so great that the streams had but little effect. The roof and floors collapsed in an hour and a half. Falling walls wrecked two adjoining structures, killing a volunteer worker.

On the leeward side the heat became so intense that the firemen were forced to abandon their hose lines. The mill office and a dwelling in the same block with the mill quickly caught fire and were destroyed. Across the street two grocery warehouses and a garage caught fire from radiated heat and were destroyed. Fortunately, much of the land on this side was vacant, and the open spaces, together with the work done by firemen in wetting down the endangered buildings, prevented the fire from spreading further by direct or radiated heat.

The mill property itself was of relatively small value, and was not insured. The loss on other buildings and their contents, however, was estimated in the vicinity of $200,000. (H-37802.)

Fires in Which There Was Loss of Life.

Second Quarter, 1934.

Since the publication of the April QUARTERLY, the N.F.P.A. Department of Fire Record has received from various sources 223 reports of fires in which there has been loss of life. A total of 359 lives were lost in these fires. Included in these tables, under the classifications "Institutions" and "Trapped in Burning Buildings," are the 22 fatalities incident to the Lynchburg Transient Bureau fire of March 24, 1934. A report of this fire appeared in the April, 1934, QUARTERLY, page 301, but the fire was not included in the loss of life tables of that issue, as the full extent of the loss of life had not been determined at that time. The April QUARTERLY also contained, on page 290, a brief account of the Hakodate conflagration in Japan, in which the loss of life was reported as 1989. Since that time deaths have mounted to a new total of 2018.

Loss of Life Fires, April-June, 1934.*

This is a typical rather than a complete record, presented to show the conditions under which loss of life occurs, that they may be known and guarded against. The total loss of life by fire in the United States is estimated at 10,000 annually.

Class of Fire	No. Fires	Men	Women	Children	No Data	Total
Airplane fires	10	20	4	0	0	24
Apartments, hotels, lodgings, etc.	14	15	7	8	0	30
Automobile fires	14	16	4	0	3	23
Barns and stables	2	2	0	0	0	2
Building under construction	1	1	0	0	0	1
Dwellings—Rural	53	14	20	50	0	84
Dwellings—Urban	61	22	30	25	0	77
Fireworks factory	2	1	3	0	0	4
Forest or brush fire	2	4	0	0	0	4
Garages	2	3	0	2	0	5
Gasoline filling station	1	1	0	0	0	1
Industrial occupancies	17	31	0	0	0	31
Institutions	4	23	2	0	0	25
Mercantile occupancies	4	4	1	0	0	5
Mining property	1	2	0	0	0	2
Oil wells and refineries	2	2	0	0	0	2
Other buildings	8	8	1	0	0	9
Outside of buildings	15	3	1	11	0	15
Railroad accidents	1	3	0	0	0	3
Response to alarms	2	3	0	0	0	3
Ships and boats	4	4	0	0	0	4
Tank ships	1	3	0	0	0	3
No data	2	2	0	0	0	2
Total	223	187	73	96	3	359

*This table is made up from those reports received by the Department of Fire Record between April 1 and June 20, 1934. A few of the fires included herein occurred prior to April 1, but were not reported until subsequent to that date.

Causes of Loss of Life, April-June, 1934.

Fatalities classified according to the immediate cause of the loss of life rather than according to the cause of the fire.

Causes	Men	Women	Children	No Data	Total
Airplane fires	20	4	0	0	24
Automobile fires	16	4	0	3	23
Children alone in house	0	0	13	0	13
Children and matches	0	0	6	0	6
Cleaning with gasoline	1	0	1	0	2
Clothing ignited:					
Bonfire, rubbish fire	4	1	7	0	12
Electric plate	0	0	1	0	1
Fell on oil stove	1	0	0	0	1
Fireplace	0	2	1	0	3
Hot ashes	0	1	0	0	1
Hot cooking utensil	0	1	0	0	1
Matches in pocket	1	0	0	0	1
Miner's lamp	0	0	1	0	1
Short circuit in radio	0	1	0	0	1
Stoves, furnaces, boilers	2	10	4	0	16
No data	0	0	1	0	1
Escaping from fire—jumped	0	2	0	0	2
Explosion or flash fire:					
Acetylene torch ignited fumes in tanker	3	0	0	0	3
Alcohol, sealing can with hot wax	1	0	0	0	1
Bake oven	0	1	0	0	1
Fireworks factory	1	3	0	0	4
Gas in basement	4	0	1	0	5
Gas in japan oven	1	0	0	0	1
Gas in mine	2	0	0	0	2
Gas stove or heater	1	2	0	0	3
Gasoline still	1	0	0	0	1
Gasoline stove	1	1	3	0	5
Gasoline tank	1	0	0	0	1
Grain dust	7	0	0	0	7
Incendiary	2	0	0	0	2
Natural gas compressor	1	0	0	0	1
Oil refinery	2	0	0	0	2
Oil stove, lamp, lantern	5	3	1	0	9
Oil well	1	0	0	0	1
Tar tank	3	0	0	0	3
No data	2	0	0	0	2
Fire fighting	14	0	0	0	14
Forest and brush fire fighting	4	0	0	0	4
Gasoline used to start fire	2	1	0	0	3
Ignition of flammable liquids or vapors	3	1	3	0	7
Kerosene used to start fire	2	8	11	0	21
Overcome by fumes—pyroxylin	3	0	0	0	3
Overcome by smoke—suffocation	4	2	7	0	13
Overexertion or excitement	2	1	0	0	3
Railroad accidents	3	0	0	0	3
Re-entering burning buildings	2	1	1	0	4
Response to alarms	3	0	0	0	3
Smoking in bed	5	1	0	0	6
Trapped on burning boat	2	0	0	0	2
Trapped in burning building	54	20	34	0	108
No data	0	2	0	0	2
Total	187	73	96	3	359

Typical Loss of Life Fires.

Children Alone.

L-2519. HEARST, ONT., APRIL 15, 1934. Two children, the oldest two years old, were burned to death when fire destroyed the frame cabin in which they lived, while their parents were working outside. A five-year-old child, who is thought to have been playing with fire, causing the blaze, escaped.

L-2506. TAUNTON, MASS., JUNE 8, 1934. A five-year-old child died in a hospital from burns received while playing with matches in the yard of her home while her parents were away. A motorist heard the child screaming and beat out the fire, but she was fatally injured.

Cleaning with Naphtha.

L-2514. MT. VERNON, N. Y., JUNE 3, 1934. A man was fatally burned while cleaning a hat with naphtha in his place of business when a stranger came in and lighted a cigarette. Naphtha fumes were ignited and the clothes of the victim, who was holding the can of naphtha, ignited. He ran down the street until he met a policeman, who beat out the fire and sent the victim to a hospital, where he died.

Clothing Ignited by Bonfires.

L-2508. ORLANDO, W. VA., APRIL 2, 1934. While standing beside a bonfire in her yard an elderly woman received fatal burns when her clothing ignited.

L-2510. NEAR CENTERVILLE, S. D., APRIL 17, 1934. A two-year-old boy was fatally burned while watching an older brother burn trash in the yard. The older boy turned to gather more trash, when the little fellow's clothing ignited. The brother and mother beat out the fire and the child was rushed to a hospital, where he died.

L-2512. OAKLAND, CALIF., APRIL 28, 1934. A four-year-old girl was burned to death when her dress caught fire as she danced around a burning rubbish heap in front of a neighbor's home.

Clothing Ignited from Radio.

L-2513. HOLYOKE, MASS., APRIL 9, 1934. A woman's clothing was ignited as she sat beside her radio, when a short circuit in the instrument ignited a pyroxylin tuning dial disc which fell on her clothing. She was fatally burned. A contributing cause of the accident was that the instrument had been removed from its cabinet because the woman associated the cabinet with a son recently deceased. The cabinet would have undoubtedly prevented the burning pyroxylin from falling from the set.

Smoking in Bed.

L-2521. CLARKSBURG, W. VA., APRIL 25, 1934. A hotel guest lost his life in a fire caused when a cigarette ignited the mattress of his bed. Apparently awakened during the night, the man smoked a cigarette, which started a smouldering fire after he fell asleep again.

FOR THE MEDICAL AND DENTAL PROFESSIONS...

EASTMAN
SAFETY FILMS

●

ALL Eastman X-ray and Dental X-ray Films, as well as Cardiographic Film, are made on "safety" base exclusively. Other Eastman films suggested for clinical photography—*Process, Portrait Panchromatic, Par Speed* and *Super Speed Portrait*—are available with either acetate or nitrate base. In ordering these the user need simply specify "safety base" and he will get, at no extra cost, film that presents even less hazard than newsprint paper.

●

EASTMAN KODAK COMPANY
ROCHESTER, NEW YORK

For Class 1, Group D, Hazardous Locations

200 watts, with totally enclosed lamp and reflector.

A Complete Line of *Benjamin* EXPLOSION PROOF Lighting Fixtures

Listed as Standard by Underwriters' Laboratories

Especially designed for installation in Class 1, Group D, Hazardous Locations—defined by the Underwriters' Laboratories as "Atmospheres containing the vapors of gasoline, common petroleum, ethyl alcohol, methyl alcohol, acetone and lacquer solvents."

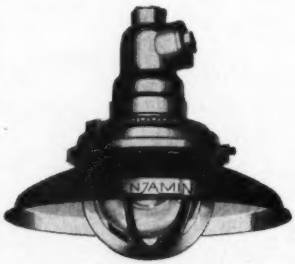
These fixtures, which combine improved illumination with dependable protection against the explosion hazard, are a departure from the conventional design of lighting equipment for these locations.

The body is of heavy, ribbed aluminum. All parts are of ample strength, designed to withstand internal explosions without breaking down or permitting flame to escape.

Lamp and reflector are entirely enclosed in the heavy duty housing.

The heat-resisting cover glass may be easily removed for lamping.

Fixtures can be furnished in either pendent type for rigid conduit mounting or with ceiling junction box.



100 and 150 watts, with or without reflector.

Benjamin Explosion Proof Fixtures are also available in 100- and 150-watt sizes. Lamp is enclosed in a special heat-resisting glass globe, designed to withstand high internal pressures, and porcelain enameled steel reflectors may be attached to the fixture.

BENJAMIN ELECTRIC MFG. CO.

General Offices and Factory

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Divisional Sales Offices

NEW YORK :: CHICAGO :: SAN FRANCISCO

Where you STOP
makes or mars where you GO

A summer holiday spent at Chalfonte-Haddon Hall offers you the excitement or complete repose your pent-up spirit craves. • If the smell of ocean fills you with an urge for action, the beach is right at our door. Take a tingling plunge in the surf. Then toast on the sand while a salt breeze blows your cares out to sea. If you want to make a day of it, lunch in your bathing togs at our smart Surf Club Grill. Golf and tennis will wait till tomorrow. Fishing, too. In the evening, dances, game rooms, concerts and varied entertainments will keep you going at a happy pace. • Or, if you cherish leisure above exercise, woo it here undisturbed. Roll up in sunshine on our broad Ocean Decks and drop slowly off to sleep. Charm away weariness in our stimulating health baths. Rest or read in the cool, quiet lounges, and dine with the relish of a rescued castaway. • Whatever you expect of a summer holiday, you'll find it abounding here at Chalfonte-Haddon Hall. Chiefly, you'll find a warm hospitality and a total freedom from noise and confusion. Reasonable rates. American and European plans.

LEEDS AND LIPPINCOTT COMPANY

Chalfonte-Haddon Hall

ATLANTIC CITY

NOFUZE "DE-ION" BREAKERS *make wiring protection* PERMANENT

Above—*Cutaway view of a Westinghouse "De-ion" Circuit Breaker similar to those used in the Panelboard shown below.*

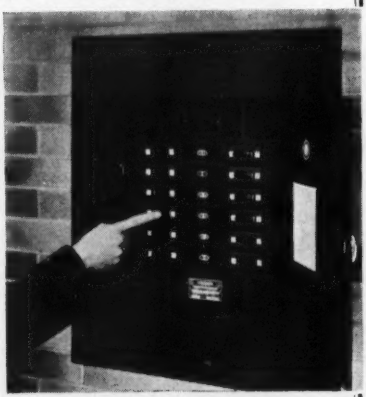
THERE is nothing to burn out or replace when electrical circuits are protected by Westinghouse Nofuze devices. Their "De-ion" Circuit Breakers, which replace fuses, provide *permanent, certain* protection that is tamper-proof. They completely eliminate the hazards of blocking blown fuses with pennies, wires and other makeshift electrical conductors.

Protection is *permanent* because the "De-ion" Breakers are accurately calibrated at the factory, and *sealed* in a molded housing.

Protection is *certain* because the breaker trips free from its handle when interrupting the circuit under harmful overload conditions. No one can hold it closed, or block its opening action.

"De-ion" breakers are used on Westinghouse Nofuze Load Centers and Panelboards for homes and buildings, and on Nofuze Circuit Breakers for industrial applications. *They are approved by the Underwriters' Laboratories.*

Below—*A Westinghouse Nofuze Panelboard. When a short circuit or heavy overload occurs, the breaker protecting that circuit automatically opens. After the overload is removed, and only then, service can be restored instantly by a mere flip of the breaker handle.*



Westinghouse

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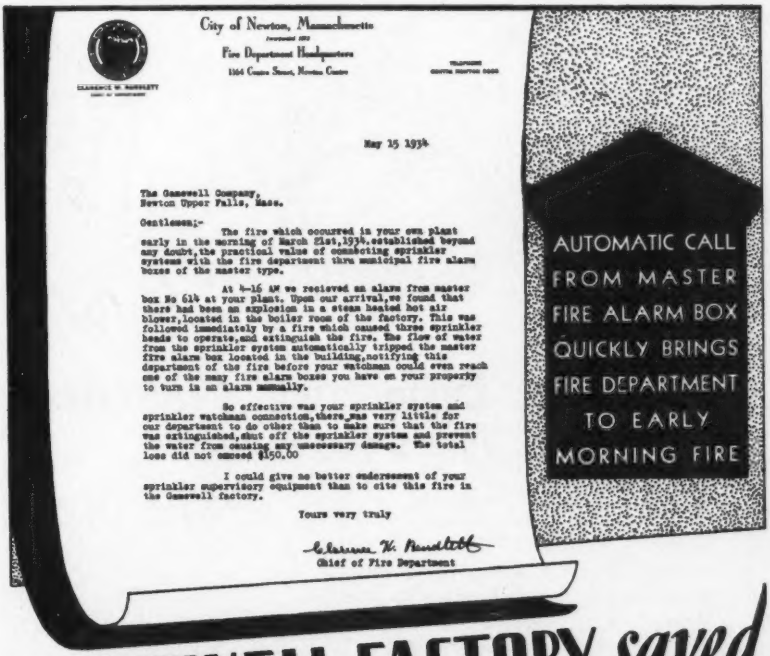
City of Newton, Massachusetts
Fire Department Headquarters
May 25 1934
The Gamewell Company,
Newton Upper Falls, Mass.
Gentlemen:-
The fire which occurred in your own plant early in the morning of March 21st, 1934, established beyond any doubt, the practical value of connecting sprinkler systems with the fire department thru municipal fire alarm boxes of the master type.
At 4-16 AM we received an alarm from master box No 614 at your plant. Upon our arrival, we found that there had been an explosion in a steam heated hot air blower, located in the boiler room of the factory. This was followed immediately by a fire which caused three sprinkler heads to operate, and extinguish the fire. The flow of water from the sprinkler system automatically tripped the master fire alarm box located in the building, notifying this department of the fire before your watchman could even reach one of the many fire alarm boxes you have on your property to turn in an alarm manually.
So effective was your sprinkler system and sprinkler watchman connection, there was very little for our department to do other than to make sure that the fire was extinguished, shut off the sprinkler system and prevent the water from causing any unnecessary damage. The total loss did not exceed $150.00
I could give no better endorsement of your sprinkler supervisory equipment than to cite this fire in the Gamewell factory.
Yours very truly
Chief of Fire Department
AUTOMATIC CALL FROM MASTER FIRE ALARM BOX QUICKLY BRINGS FIRE DEPARTMENT TO EARLY MORNING FIRE

GAMEWELL FACTORY *saved* FROM HEAVY FIRE LOSS —by OWN APPARATUS

It wasn't necessary for us to have an explosion and fire in our own plant to convince us of the value of connecting sprinkler systems with the municipal fire department through a Gamewell master fire alarm box *(known as the Sprinkler Watchman)*. The service record of our *Sprinkler Watchman* hook-up in hundreds of other properties had convinced us of that.

Fire Chief Clarence W. Randlett of Newton, Mass., tells us in the above letter how our *Sprinkler Watchman* hook-up saved our own plant from a heavy loss. This is just one more case illustrating the value of a sprinkler system connected to the fire department through the dependable Gamewell master fire alarm box.

Every insurance company should encourage its sprinklered risks to install this Gamewell *Sprinkler Watchman* hook-up. It will save thousands of dollars in fire and water losses. Shall we send you literature?

THE GAMEWELL COMPANY

Newton, Massachusetts.

"A Box a Block"

Advanced Engineering Principles

Outlined in this **FREE** *Book . . . .*

Are you familiar with the latest engineering developments in automatic fire protection? The Viking Corporation, alert to changing conditions, and conducting extensive research, has recently published the book pictured above, which gives valuable information about this important phase of industry.

In this book are discussed the Viking Dry Pipe System and the Viking Wet Pipe System. A companion book deals with Viking Pre-Action and Deluge System.

Write for your free copy of either or both of these books today.

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Indianapolis, Indiana—Indiana Automatic Sprinkler Co.
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ONE model for the large plant or office building with many watchmen following each other at intervals.

ANOTHER for the small plant with one watchman, or where each watchman makes his rounds in a particular section.

THERE is a system for supplying an exact-to-the-minute check on each watchman's movements.

STILL another model keeps an accurate record of a watchman's movements for a week or more without supervision.

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DETEX

WATCHMEN'S CLOCKS

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A Fire Record Service

The determining of actual fire experience for various types of occupancies, whether manufacturing plants, mercantile establishments, or other occupancies, is made possible for N.F.P.A. members and other Quarterly readers who make use of the facilities of the Department of Fire Record at the executive office.

Detailed reports of more than 107,000 fires are on file, classified according to the occupancies involved, and cross-indexed for features of interest to the fire protection field. This material has been the basis of the fire records published from time to time in the Quarterly. Limited publication facilities, however, necessitate selection for Quarterly use only the fire records judged to be of most general interest. Thus but a small fraction of the available data is published and there exists at the executive office a veritable mine of unpublished fire record information, much of which is readily accessible.

Many requests for fire record information involve only a small amount of work and this is done for members as a part of the regular N.F.P.A. membership service. Where, however, special research is involved a moderate charge is made. We suggest that you present your problem to the Department of Fire Record, where it will be given an analysis of the same high standard as all other technical work of the Association.

A folder describing this department in detail, and charges made for special research work will be furnished upon request.

NATIONAL FIRE PROTECTION ASSOCIATION

60 Batterymarch Street - - Boston, Massachusetts

11

CENTRAL STATION Sprinkler Supervisory Service provides 11 *point* protection because in addition to summoning the fire department by automatically transmitting a speedy and accurate alarm when water flows from the sprinkler system, A.D.T. Sprinkler Supervisory Service includes ten other important safeguards:

It automatically reports . . .

1. Opening or closing of shut-off valves,
2. High or low air pressure in dry pipe systems;
3. High or low water in gravity tanks;
4. Low temperature in gravity tanks;
5. High or low air pressure in pressure tanks;
6. High or low water in pressure tanks;
7. Power supply to fire pumps cut off.

8. All electrical circuits are under the constant supervision of the Central Station.

9. A.D.T. assumes full responsibility for the inspection and maintenance of the entire supervisory system.

10. Every alarm is investigated immediately by Central Station operatives and is closely followed up until normal conditions are restored.

94,230 sprinkler waterflow and supervisory signals were received in A.D.T. Central Stations during 1933...all indicated conditions requiring immediate correction and were speedily and effectively acted upon.

•

This 11 point protection, supplied only by A.D.T. Service, assures instant automatic reporting of fires and that sprinkler systems receive the care and attention necessary for successful operation. We shall be glad to send you descriptive literature.

11 point protection

CONTROLLED COMPANIES OF

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PROTECTION

AGAINST FIRE AND THEFT

Another Milestone on the Road of Progress

GRINNELL
QUARTZOID
BULB SPRINKLER

Similar in appearance and method of operation to the well-known quartz bulb sprinkler, it has all the advantages of the latter, yet costs but little more than the ordinary solder type. It carries the art of automatic fire protection to a higher degree of perfection for the following reasons:

- It is fast, opening in the very early stages of a fire.
- It retains this speed because its operating element, the quartzoid bulb, is unaffected by corrosion.
- It is longer lived, since the quartzoid bulb is unaffected by age and exposure.
- Its opening action is very forceful, so that loading and encrustation are not likely to defeat its operation.
- Its new streamline deflector distributes water better with minimum loss of energy and velocity.
- Its new smooth, tapered discharge nozzle is less likely to be clogged by sediment.
- It is exceptionally strong mechanically and not easily damaged by rough handling.
- It may be used in the pendent as well as the upright position with no loss of effectiveness.
- Its strength is not impaired by repeated exposure to temperatures near the opening point.
- Its small size and symmetry make its use desirable where good appearance is important.

GRINNELL COMPANY
INC.

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PROVIDENCE RHODE ISLAND

Offices in all Principal Cities of the United States and Canada.